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GEOLOGY AT THE BRITISH ASSOCIATION, 1895.

THE British Association for the Advancement of Science held its sixty-fifth meeting this year at Ipswich, the chief town in Suffolk, in the east of England, the district in which the Pliocene rocks of the country are best developed. The Section of Geology was presided over by Mr. W. Whitaker, who was engaged for many years in mapping these rocks for the Geological Survey. The address delivered by this gentleman on the opening day, September 12th, naturally dealt with local problems, and especially those raised by the numerous deep borings for coal and water which have been put down through the rocks of eastern England.

Neglecting deposits newer than the Gault, the variations of which are slight and of but little consequence, he notes that the Lower Greensand has only been met with in one boring, that of Culford, where it is 32 feet thick and of anomalous character, preparing us for the thinning out which occurs elsewhere. Jurassic rocks are only present in the southern borings and do not occur in Suffolk. Under the Jurassic or Cretaceous rocks the Trias is supposed to occur in one case and in the others strata belonging to the Carboniferous, Devonian and Silurian Systems. In five bores out of ten put down under the London Basin the determination of the age of the rocks is aided by fossil

evidence, but in the rest this support is wanting. The general result is to prove that over an area not less than 86 miles from northwest to southeast older rocks almost certainly occur everywhere at a distance of not more than 1600 feet from the surface.

The only boring in eastern England which has struck productive Coal Measures is that at Dover, where evidence from the Continent was at hand to aid in fixing the exact position for the trial locality, but two or three others have struck Carboniferous rocks at a horizon below that at which workable coals are usually found, thus proving that there are Carboniferous rocks in the eastern counties, and showing that there is every likelihood of eventually meeting with productive measures if exploration is persisted in. The Stutton experimental boring, on which the President read another paper in the course of the meeting, after passing through 1000 feet of Neozoic rock had struck on Palæozoic rock and was being continued through it in the hope that some satisfactory evidence of the age of the latter rock would be forthcoming. It had then reached the depth of 1350 feet and the lithological character of the rock resembled Carboniferous or Ordovician shale. The section of the bore hole is given below:

	Feet.
Drift (River Gravel)	16
London Clay and Reading Beds	54
Upper and Middle Chalk	720
Lower Chalk, with very glauconitic marl at the base (almost a green sandstone)	154½
Gault	49½
Palæozoic Rock' with a high dip.	

In conclusion Mr. Whitaker stated that, even if it was necessary to abandon the present experiment, it was intended to make one or possibly two more trials, so as to have a fair chance of really settling the question of the occurrence of coal in East Anglia. Taking up the question thus prominently brought forward by the President, Mr. Harmer advocated that the systematic survey of deep-seated rocks by means of borings should become one of the duties of the Geological Survey. Anticipating that valuable economic discoveries of coal, water, iron and other products were only a question of time, he stated that the starting of new industries in agricultural districts, the appreciation in the value of land, and if necessary the imposition of a royalty on minerals worked beyond a certain depth, would far more than pay the expenses of such systematic work, whilst, under the present state of the law, no private individual cared to undertake deep exploration, because his very success would only bring him into competition with those who would profit by his discoveries without sharing his risks.

Mr. Whitaker likewise contributed to the Section a paper on deep wells in Suffolk; six of these penetrate the Tertiary rocks and reach the chalk.

A paper of very great importance was that by Mr. Joseph Francis on methods for determining the direction of dip in strata at the bottom of deep borings, methods which have proved quite successful at depths of 1,000 feet and might be applied to almost any depth. The author had carried out his experiments at the borings at Ware and Turnford, and, after abandoning plans dependent on fastening a compass needle on the top of the core, he fell back on the method of lowering the rods with the utmost care to prevent twisting, and checking the result by equally careful raising and the lifting of wax moulds of the top of the core. The crown of the boring-tool was furnished interiorly with three sharp steel points so arranged as to give a line in a known direction; these points on descending ruled three lines on the side of the core

which was then broken off, lifted, and the angle of the diametral line with the direction of dip measured. A test experiment was also arranged by grinding the surface of the next piece of core and impressing a line of points on it by lowering a steel bar armed with punches on to the smooth surface; on raising this core it yielded a measurement within a degree of the preceding observation. The Palæozoic rocks at Ware aud Turnford gave dips a little west of south.

Owing to the presence of many observers who had worked in East Anglia, local papers were numerous. First came two by Mr. Harmer, a gentleman who was for many years the colleague of Mr. Searles Wood, Jun. One dealt with the commonly occurring species of Mollusca of the Coralline Crag deposits and showed that this assemblage, even better than the total fauna, proved the southern derivation of the organisms. The summaries given by him are printed below:

Summary of the abundant and characteristic species of Mollusca occurring in the Coralline Crag.

Not known as living (37 per cent).....	89
Living in distant seas.....	8
Living in the Mediterranean.....	133
Living in the West European area.....	9
Living not south of Britain.....	1
Total.....	240

Species of European Mollusca occurring abundantly in the Coralline Crag.

Southern and not British (28 per cent).....	42
British (rare) and Southern..... (35 per cent).....	9 51
British (characteristic) and Southern.....	91
British and not Southern.....	1
Total.....	143

Mr. Harmer's second paper dealt with the so-called derivative shells in the Red Crag; while admitting that the Eocene species had undoubtedly been derived from an older deposit, the author contended that many of these shells had lived in Britain in much later times, some belonging to the interval which elapsed between the formation of the Red and Coralline Crags. Mr. Clement Reid gave an illustrated lecture on the glacial deposits of Cromer, which were visited later on by a large party under his guidance. The Cromer drift is remarkable for the contortions which it exhibits, and, indeed, it frequently displays all the structural phenomena of the crystalline schists, being sheared, crumpled, brecciated, twisted and kneaded into 'eyes.' The same author in conjunction with Mr. H. N. Ridley described the discovery of a new bed containing temperate plants between the morainic deposits and those with arctic plants at Hoxne, a locality long famous for the palæolithic implements found in its upper strata; he proposes to investigate this deposit still further and to determine the relation of the human remains to the various climates indicated by the plants and moraines.

The following is the section exposed:

	Feet.
Gravelly surface soil.....	about 2
Brick earth; towards the base *Valvata piscinalis*, cyprids, bones of ox, horse, elephant (?), and palæolithic implements.....	12
Sandy gravel, sometimes carbonaceous, with flint flakes.....	1
Peaty clay, with leaves of Arctic plants (?).....	about 4
Lignite, with wood of yew, oak (?), white birch, seeds of cornel, etc...	about 1
Green calcareous clay, with fish, *Valvata piscinalis*, *Bythinia tentaculata*, *cyprids*, *Ranunculus repens*, *Carex*.....	about 4
Boulder clay.....	

Recent storms at Southwold, on the east coast, have effected considerable denudation there and have directed attention to

the amount of this action which is measurable within recent years; Mr. Spiller estimates this amount to vary between 10 and 84 feet in six years at different points along the coast. Mr. H. B. Woodward describes the section exposed by the storm just mentioned: Norwich Crag below the Chalky Boulder Clay, and above that a bed containing fresh water shells followed by a peaty deposit.

A paper by M. G. F. Dollfus, on the probable extension of the seas during Upper Tertiary times in western Europe, is so important that we give a full abstract of it:

Taking into consideration the positive nature of all the outliers of Upper Tertiary age, the author is led to the following conclusions as to the extension of the Neogenic seas in western Europe. During Miocene times England was united to France, and we have proof of the existence of two seas in the western part of Europe; one on the east extended over part of Belgium (Bolderian system), Holland, and north of Germany—probably this sea was not very far off the eastern coast of England; the other sea, the Western, or old Atlantic Sea, was off Ireland, penetrating in various gulfs into France, as in some part of Cotentin, Brittany, in the Loire valley, in the Gulf of the Gironde, but there was no way of communication with the Mediterranean basin crossing France. In north Spain there are no Miocene deposits; in Portugal Miocene beds are purely littoral.

The communication with the Mediterranean Sea was certainly by the valley of the Guadalquivir. The Gibraltar Strait had not exactly its present place. The fauna of these Miocene coasts was warm and very similar to the existing fauna of Senegal and Guinea.

We can divide Pliocene time into three periods, but the situations of the seas were not very different. England was always in direct continental communication with France, the English Channel was not open at all. All the Pliocene deposits of Belgium, north France, or England, even the Lenham beds, are on the side of the North-Eastern Sea; we find all these patches on the northern side of the great anticlinal line of the Artois, Boulonnais and Weald. The fauna is different from the Miocene, and colder; it even turns more and more cold during the progress of Pliocene time. On the western or Atlantic side we have little gulfs, leading the sea into the land, but not so frequently and not so far as during Miocene times. The Cornwall deposits, Cotentin beds and the Brittany patches are very limited; the basin of the Gironde contains no trace of Pliocene beds, and we have no trace of recent marine beds at the foot of the Pyrenees. In the north of Spain there is also no trace of Pliocene beds. The continent seems to have been higher, and the Atlantic tolerably distant. All the Portuguese sands recently discovered are littoral, and only on the Algarve coast and south of Spain do we find proof of the probable communication with the Mediterranean. The Gibraltar Strait was not always in the same place during Pliocene time; in the beginning probably the Guadalquivir valley to Murcia continued to be the strait, but later the rock of Gibraltar was separated from Africa and a new road was open; this way was certainly deeper than the former one, and as deep as the existing strait. By this depression the cold fauna of the depths of the Atlantic penetrated into the Mediterranean Sea as far as Sicily and Italy with *Cyprina Islandica*.

The geology of Morocco is unknown, but we have plenty of information on Algeria. We have there great Miocene deposits raised along the Atlas Chain up to a great altitude, and a little lower a good and very long band of Pliocene beds of marine and continental origin. Quaternary deposits, similarly continental and littoral, occur lying along

the actual coast, pointing out the south side of the Mediterranean connection.

In a few words, the English Channel has been opened very recently, and no sea occupied its place before. No sea has crossed France or central Spain, and we are obliged to seek for an outlet for the Eastern Sea during Miocene time by way of Germany, Galicia and south Russia, or by the north of Scotland.

During the existence of the Pliocene seas there was no other communication for the Crag seas than the northern one, for the western, the south and eastern sides were undoubtedly shut in by land.

M. Van den Brœck followed with a note on the present state of our knowledge of the Upper Tertiary strata of Belgium. He had determined that the Upper Oligocene strata did not exist in Belgium, but that the Upper Pliocene was probably present there. He concluded that the line of march of the Miocene fauna was from east to west, for Miocene forms present in Belgium were absent from England. That the Miocene formation had been once present in England he inferred from the fact that half the Belgian Miocene fauna was to be found in the Coralline Crag. M. M. Boule described some interesting finds in gravel in France, the deposit containing bones not only of *Elephas meridionalis*, but of *E. antiquus* and of the Mammoth, the former being in contact with palæolithic flints, the latter bearing tusks nearly three metres in length.

Several American gentlemen either read or sent papers to the meeting, including Professors Marsh, W. B. Scott, E. W. Claypole and Mr. R. B. White. The account of Professor Marsh's paper given by the *Times* is as follows:

"Professor Marsh described his restorations of some European Dinosaurs, and offerred suggestions as to their place among the Reptilia. He said that he had examined nearly every specimen in Europe, and, from minute comparison with the eight chief American types, mostly found in the Rocky Mountain regions, had restored four European forms, viz.: Compsognathus, Scelidosaurus, Hypsilophodon and Iguanodon. The Dinosaurs were all land animals, none being known as arboreal or aquatic. They varied in size from that of a chicken to gigantic monsters 80 ft. in length. Most were probably carnivorous; the Iguanodon, however, was herbivorous. The Compsognathus was found in the Jurassic Solenhofen slates near Munich. Its footprints resembled those he had shown Professor Huxley in the mud layers in the Connecticut Valley. Huxley considered them footprints, not of birds, but reptilian, and made by true Dinosaurs, and drew a bipedal animal about the size of a turkey conforming to the size of the footprints. It was a typical example of a true carnivorous Dinosaur. The Scelidosaurus was found in the Lias of England, a quadruped about 30 ft. long, with its back partly covered with a coat of mail. He had restored its fore feet by analogy with the quadrupedal Stegosaurus ungulatus of America, one or two specimens of which he had found, 30 ft. in length, just as the animal had fallen down to die, with every bone in position. The Hypsilophodon was found in the same geological formation. It had an ossified sternum, and in this respect differed from the American allied form. Much doubt had been entertained concerning the Iguanodon till the wonderful discovery of about 30 specimens in Belgium in their exact position at the time of death. As to the question of the true place of Dinosaurs amongst reptilia there had been great diversity of opinion. The crocodilian form Hallopus was regarded as a Dinosaur, but it differed from all other Dinosaurs in the long metatarsus and the backward projection of the calcaneum. But there were certain affinities between Dinosaurs and the crocodilian form

Aëtosaurus. The Dinosaurs were found at the base of the Jurassic strata. There was no evidence for their existence in the Tertiary period, but much against it. Owing to their appearance in the Wealden strata, if the evidence derived from Vertebrates is to be regarded as conclusive, the Wealden must be considered as belonging, not to the Cretaceous, but to the Jurassic formation."

Professor E. W. Claypole's paper on 'The Cladodonts of the Upper Devonian of Ohio' was as follows: Numerous specimens of the Cladodonts of the Cleveland Shale in Ohio have been found by Dr. Wm. Clark. They for the first time reveal to us the general form of the fishes to which belonged the teeth that have alone so long represented the genus *Cladodus*. The fossils are in very fair preservation, but their state of pyritization has obscured many of the details of their structure. So far as regards their form, however, we now know that they were long, slender fishes, resembling in their character the sharks of the present day; that they possessed well-developed and powerful pectoral and caudal, with weak ventral fins, the dorsals being unknown; that they were for the most part, or altogether, spineless; that at least one species possessed cladodont teeth of more than one pattern; and that they had near the hind end of the body a peculiar flat expansion or membrane of rudely semicircular form, which gave to the caudal extremity when seen from above the outline of a sharp-pointed shovel.

The largest whole specimen yet found shows a fish of about 6 feet in length, but detached teeth and other fragments indicate others of double this size, and supply abundant proof that in late Devonian times, and in the North American area, the elasmobranch fishes had attained very great proportions and a high stage of development.

Hitherto the Cladodonts have been regarded as, in the main, characterizing the Lower Carboniferous rocks, but we now find them abounding in the earlier Devonian strata, and, as shown by the contents of their stomachs, preying, in some cases at least, on the smaller placoderms of the same area.

From the evidence of the new specimens it appears most likely that the species already defined from single and isolated teeth can no longer be maintained.

For details see the papers in the American Geologist for 1893–4–5.

Professor Claypole also read a second paper, illustrated with specimens on 'The Great Devonian Placoderms of Ohio.' The Upper Devonian Shales of Ohio have recently afforded a remarkable series of fossil fishes rivalling in size and interest those found many years ago in the Old Red Sandstones of similer age, in Scotland, and described by Agassiz and Hugh Miller. The earliest of these, *Dinichthys*, was closely studied, and its structure was well explained by the late Dr. Newberry. It was an immense armor-clad fish whose head measured from 2 to 3 feet in length. *Titanichthys*, the second of the group, though less massive, was of yet larger size. *Gorgonichthys*, the third, was described by the speaker in 1893, and, so far as is yet known, was the most formidable of all, possessing jaws of enormous size and thickness, above 24 inches long, ending in teeth or points from 6 to 9 inches in length. The last of the four, *Brontichthys*, of which a description was also published in the American Geologist for 1894, is equally heavy and of equal size, but differs from all the rest in possessing very massive symphysial portions in the mandibles with sockets apparently for the reception of teeth, as in *Titanichthys*.

Of the two last-named genera only the jaws are yet known with exactness. Other portions have been found of *Gorgonichthys*, but are still imbedded in the matrix. So far as can at present be determined, all the

four are closely related to *Coccosteus*, and belong to the same family.

The set of casts exhibited in illustration of the fossils has been prepared by their discoverer, Dr. William Clark, and faithfully represents the originals, of many of which only single specimens are yet known. The labor of extricating them from the pyritous shale has proved very heavy, and much yet remains to be done in this direction.

Professor W. B. Scott illustrated, with a large number of slides, his paper on 'The Tertiary Lacustrine Formations of America.' In Tertiary times one lake succeeded another, giving an almost complete record of that era in lacustrine deposits. Professor Scott suggested the annexed correlation of these deposits with the standard strata of Europe:—

9. *Equus* beds		Pleistocence.
8. Blanco formation		Pliocene.
7. Loup Fork beds		Upper Miocene.
6. John Day beds		Lower Miocene.
5. White River beds		Oligocene.
4. Uinta beds.	Eocene	Paris Gypsum.
3. Bridger beds.		Parisien.
2. Wasatch beds.		Suessonien.
1. Puerco beds.		Cernaysien.

A considerable break occurs between 3 and 4 and earth-movement then took place, while a second hiatus is seen between 6 and 7. 3, 5 and 7 are each divided into three divisions, and the highest division of the Loup Fork beds, the Palo Duro, may be correlated with the basal Pliocene. The Uinta beds were the evidence of the last lake west of the Rocky Mountains; the lakes afterwards spread east to the great plain.

The paper by Mr. R. B. White, 'On the Glacial Age in Tropical America,' described a number of apparently glacial deposits in the Republic of Colombia, almost under the equator. He spoke of moraines forming veritable mountains, immense thicknesses of boulder clay, breccias, cement beds, sands, gravels and clays, beds of loess, valleys scooped, grooved and terraced, monstrous erratics and traces of great avalanches. It is a significant fact that over part of the area the author supposes the ice period to be contemporaneous with great volcanic activity, so that the glaciers bore on their surfaces little but loads of pumice, ash and ejected blocks; in other places, however, the detritus appears to have been derived from sedimentary rocks. The paper concludes with some remarkable speculations as to the cause of glacial periods.

Dr. H. Woodward read an interesting paper on some decapod crustaceans from the Cretaceous formations of Vancouver Island, in which he described four new species from specimens sent him by Mr. J. F. Whiteaves. These are named as follows: *Callianassa Whiteavesii*, *Palæocorystes Harveyi*, *Plagiophthalmus? Vancouverensis and Homolopsis? Richardsoni*. Some of these forms approach very close to European Cretaceous types.

Turning now to the subject of palæontology, a paper which is fraught with far-reaching consequences in the near future, is that entitled 'Notes on the Phylogeny of the Graptolites,' by Professor H. A. Nicholson and Mr. J. E. Marr.

The authors note that the number of stipes possessed by graptolites has been looked upon as a character of prime importance, many genera being based on the possession of a certain number. Again, the 'angle of divergence' has been looked upon as an important factor in the diagnosis of families. They are, however, led to believe that a character of essential importance in dealing with the classification of the graptolites, and one which, in all probability, indicates the true line of descent, is found in the shape and structure of the hydrothecæ, the point of next importance as indi-

cating genetic relationship being the 'angle of divergence.'

These views are illustrated by reference to forms belonging to the 'genera' *Bryograptus*, *Dichograptus*, *Tetragraptus* and *Didymograptus*, which appear in turn in this sequence.

Out of nine *Tetragrapti* (and the authors know of no other forms referred to this genus which are represented by well-preserved examples), eight are closely represented by forms of *Didymograptus*, which are closely comparable with them as regards characters of hydrothecæ and amount of 'angle of divergence,' whilst the ninth is comparable with a *Didymograptus* as regards 'angle of divergence' only. Moreover, four of the *Tetragrapti* are comparable as regards the two above-named important characters with forms of *Dichograptus* and *Bryograptus* with eight or more branches, and the authors confidently predict the discovery of forms belonging to these or closely allied many-branched 'genera,' agreeing with the remaining *Tetragrapti* in what they regard as essential characters.

They give details showing the points of agreement of each group of the various series, including a two-branched, a four-branched, and a many-branched form, and point out how difficult it is to understand how the extraordinary resemblances between the various species of *Tetragraptus* and *Didymograptus* (to take one example) have arisen, if, as usually supposed, all the species of the genera have descended from a common ancestral form for each genus, in the one case four-branched, and in the other case two-branched. On the other hand, it is comparatively easy to explain the more or less simultaneous existence of forms possessing the same number of stipes, but otherwise only distantly related, if they are imagined to be the result of the convergent variation of a number of different ancestral types. They allude to similar phenomena which have been shown to exist amongst other organisms; thus Mojsisivics has described analogous cases amongst the Ammonites, and Buckman (under the name of heterogenetic homœomorphy) amongst the brachiopods, though in this instance the cases of 'species' and not of 'genera' are considered.

Following the above inferences to their legitimate conclusion, the authors point out how 'genera' like *Diplograptus* and *Monograptus* may contain representatives of more than one 'family' of graptolites, according to the classification now in vogue, which would account for the great diversity in the characters of the monograptid hydrothecæ.

In conclusion, the authors offer a few theoretical observations upon a possible reason for the changes which they have discussed in the paper.

The latter of the foregoing authors, with Mr. E. J. Garwood, also read an important paper on the zoning of the Carboniferous rocks which they had begun in the north of England. The zones so far established were the following:

Zone of *Productus* c. f. *edelburgensis*.
Zone of *Productus latissimus*.
Zone of *Productus giganteus*.
Zone of *Chonetes papilionacea*.
Zone of *Spirifera octoplicata*.

Mr. Garwood has traced the zone of *P. latissimus*, occupying the same relative position to that of *P. giganteus*, from Settle, in Yorkshire, to the Northumbrian coast, near Howick Burn.

With regard to the other papers coming under this heading it will suffice to mention that the attempt to obtain the rest of the skeleton of the Oxford *Cetiosaurus* has not as yet met with any success, and that the report on fossil Phyllopoda by Professor Rupert Jones contained a most valuable table by Professor Lapworth on the distribution of these organisms. The discovery of a new section of Rhætic rocks was de-

scribed by Mr. Montagu Browne, and Mr. Harrison reported on the flints, supposed by himself and others to have been worked by man, obtained from high level drift in Kent. Mr. Walford gave an account of the succession of rocks occurring between the Inferior Oölite and the Great Oölite in Oxfordshire as revealed by an excavation undertaken there within the year. In a paper on the auriferous conglomerates of Witwatersrand Dr. Hatch concluded that the gold must have been introduced into the rock subsequently to its consolidation, and not derived with the pebbles from an older formation.

Professor J. Milne, in an exceptionally interesting paper on earthquake phenomena, showed that the greater shocks could be felt by delicate instruments for enormous distances, even at their antipodes, and that the waves travelled faster than if the interior of the earth had the elasticity modulus of glass or steel. The observations of slight movements showed one regularly recurring set which the writer suggested might possibly be due to the evaporation of moisture by day and its deposit by night. The Committee engaged in collecting photographs of geological interest had amassed not less than 1,200, which were deposited at the Museum of Practical Geology at Jermyn St., London. Gradually this collection will form a most valuable and reliable survey of geological features and phenomena.

The committees on the erosion of sea coasts and on the circulation of underground water completed the labors on which they have been engaged for so many years, but still continue to act and now proposes to extend its scope to Scotland, where the local committee has ceased work for some years.

Amongst the papers on glacial subjects one of the most important was by Professor Sollas on artificial glaciers (or 'poissiers') made of pitch, and their bearing on theories of glacier movement and transport. Troughs were prepared of various shapes and while these were inclined they were filled with pitch in such a way that when placed in position its surface had a slope of about 12 degrees. The pitch was put in in layers, various substances, such as rice, sago, pigment, etc., being placed on each layer as it was completed, to serve as indexes of the movements within the mass. In this way it was shown that against barriers opposed to the movement of the ice, an upward movement occurred like that which had long since been postulated by geologists to account for the upward transport of erratics. A similar upward movement also was detected in the pitch where it was driven into a narrow gorge. Another point illustrated was that pitch sometimes overrode heaps of loose materials just as glaciers are known to override their moraines. Pitch conformed to all the laws of fluid motion and differed only in the element of time, and it was found that practically similar results could be obtained with Canada balsam, glycerine and even water. This enabled Professor Sollas to project on the screen not only photographs of his results, but the actual experiments themselves taking place. The author had been able to imitate experimentally some of the phenomena recently described by Mr. Chamberlin.

Several papers dealing with old, pre-Glacial valleys were read. One by Mr. Beeby Thompson called attention to the following varieties of such valleys: (1) New valleys without drift and having old, filled-up valleys near at hand; (2) Those that drift on one side and rock on the other; (3) Streams re-excavating old, drift-filled valleys; (4) Re-excavated valleys with the drift all washed down into gravel. Mr. E. Hill described a similar valley in Suffolk, and Mr. T. V. Holmes one in Essex.

Mr. P. Kendall and Mr. Lomas read a

remarkably interesting paper on modern glacial striæ, of which unfortunately no report is available: Mr. W. W. Watts contributed a note on the basins of some of the tarns near Snowden. One very small one seemed to occur in a rock basin, one was dammed at both ends by scree and stream detritus, and two larger lakes, Glaslyn and Llyn Llydaw, were either confined in true rock basins or else were not more than about 40 feet deep.

A large number of excursions was planned and carried out chiefly under the leadership of the President and Mr. Clement Reid. The various localities for the Coralline and Red Crag deposits were visited and the relations of the deposits studied, and the last two days were devoted to a pretty thorough examination of the remarkable and classical glacial deposits of Cromer on the coast of Norfolk.

W. W. Watts.
Geological Survey, London.

A COURSE IN ASTRONOMY FOR ENGINEERING STUDENTS.

At the present time our engineering schools tend more and more strongly to technical curricula which deal with professional subjects to the exclusion of non-professional matters, and the author of the present paper, approving this tendency, purposes to state here his conception of a brief course in spherical and practical astronomy as a part of the technical training of the future engineer. The purposes of such a course should be:

(A.) To give the pupil some training in the precise use of instruments of precision. His course in surveying has given the student an introduction to the use of such instruments, but the nature of that work and the circumstances under which it is done preclude the placing of any considerable emphasis upon precision of results. To demand all the accuracy which a transit or level can be made to furnish is in general bad surveying practice, but only the man familiar with refined methods of instrumental work is competent to form an intelligent judgment of the manner in which those methods should be modified and their rigor relaxed in any given case. The course in astronomy, therefore, comes as a supplement to that in surveying, and the pupil should now be taught:

(a.) That it is his business in each of his problems to obtain from his instrument all of the precision that it can be made to furnish.

(b.) He should be taught to obtain this precision with a minimum expenditure of care and time. The instinctive tendency of the student mind to execute every part of a given task with equal painstaking needs to be curbed and the pupil taught what things require minute care and what may be, and ought to be, dealt with in a summary manner.

(c.) As a subordinate matter he may be introduced to the use of instruments of a higher grade than those employed in his course in surveying.

(B.) A second purpose of the course is to train the student in the art of computing (ciphering). Model forms of record and reduction for his several problems should be placed before him and the advantage of compact and orderly arrangement of all numerical work should be strenuously insisted upon.

(C.) As the concrete outcome of the above training, the student should acquire the ability to determine latitude, time and azimuth with such instruments as he will use in the ordinary practice of civil engineering. The sextant and engineer's transit furnish quite as good an equipment for the course here contemplated as the elaborate outfit of an observatory. The latter belongs to a more advanced stage of study.

The details of a course of study such as is above suggested depend upon the amount

of time which can be assigned it in the curriculum, and as a compromise between conflicting interests we suggest a required course of sixty exercises, to be followed by an elective course, *which the student should have an opportunity to elect*, and for which he should receive credit.

THE REQUIRED COURSE. It is presupposed that the student is familiar, as a matter of common information, with the diurnal and annual motions of the earth and the rising and setting of stars. His technical instruction may begin with a formal definition of the zenith, poles, horizon, equator, meridian and an explanation of the coördinates, altitude, azimuth, declination, hour angle and right ascension, together with the geographical latitude and sidereal time, which should be introduced as concepts strictly analogous to the coördinates. An armillary sphere or some equivalent apparatus is almost essential to the ready acquisition of a working knowledge of the coördinates, and it will usually aid the student if emphasis is placed upon the fact that while any two coördinates suffice to fix the position of a star they naturally fall into pairs, altitude and azimuth, declination and right ascension, etc., the common element between the coördinates constituting a pair being that they refer to the same fundamental plane. It should be further noted that the latitude and sidereal time constitute the relationship between the different systems of coördinates, and it will be advantageous to point out the reasons for employing several different systems.

The astronomical triangle, Pole-Zenith-Star, should next be introduced as a device for transforming coördinates from one system to another, and the student's interest will be stimulated if it is pointed out to him that the practical problems with which he is soon to deal, such as the determination of time, latitude and the direction of the meridian, are in so far as their theory is concerned nothing other than cases of the transformation of coördinates.

The convenient use of the astronomical triangle for the purposes here indicated requires a knowledge of the 'general spherical triangle,' and it will frequently be found that the student's mathematical attainments are in this respect insufficient. In such cases it is often an economy of time to devote an hour to the derivation of the general formulæ of spherical trigonometry by the transformation of rectangular coördinates, accompanying the demonstration with the requisite precepts for the application of these formulæ to numerical calculation. The student should apply the astronomical triangle to the derivation of formulæ for passing from each system of coördinates to each of the others, and should preserve these formulæ for use in the reduction of his observations rather than to resort anew in each case to the triangle.

At this stage of progress the student should devote some little time to the numerical transformation of coördinates, both for the purpose of familiarizing himself with the several systems and mode of passing from one to another, and for instruction in the technique of computing, the arrangement of his work, the checks against the commission of error, the mechanical devices for economy of time and labor, and the use of addition and subtraction logarithms, which are usually neglected in the department of mathematics.

It is a common saying among experienced computers that the only way to avoid mistakes in numerical work is to have acquired experience through the commission of every possible kind of blunder, and there is perhaps no part of his course in astronomy from which the future engineer will derive more practical advantage than this training under the guidance and criticism of an accomplished computer such as every professor of practical astronomy should be.

This training in numerical work should be a prominent feature of the whole course in astronomy, and without more than a beginning in such work the student may pass to a consideration of the different kinds of time in the order, sidereal, apparent solar, mean solar time, and should learn the use of the ephemeris in so far as it deals with the concepts he has had occasion to employ. He will learn that the various quantities contained in the ephemeris are all variable with the time; that their values which he is to use must be interpolated from it for the instant at which the observation in question was made, and that this instant must be expressed in Washington or Greenwich time. This seems an exceedingly elementary matter, but it is the writer's experience that students are frequently perplexed by it and that a little care is required for its elucidation.

The order in which the student shall take up his practical problems is not a matter of primary importance, but it has been found convenient in practice to assign first the determination of time from a single altitude, or series of altitudes, of the sun, measured with the sextant, showing the student how to use the instrument and explaining its chief sources of error without going into their mathematical theory. The reduction of these observations brings the student to a consideration of the fact that the altitude which he has measured cannot immediately be employed with the latitude and declination of the sun for the solution of the astronomical triangle, but must be first transformed from an apparent into a true altitude by correcting for the effect of refraction and parallax.

The theory of the parallax may be briefly given, neglecting the earth's compression, but it will usually be better to give arbitrarily the refraction formula than to attempt its derivation. The student will usually have difficulty in determining which limb of the sun he observed, and his perplexity may be used to emphasize the advantage of observing both the upper and lower limbs. So also he will usually require some stimulus to secure the bestowal of sufficient attention upon the determination of the index correction.

The next step in his progress may be a rapid revision of the theory of the theodolite or engineer's transit which he encountered, but usually did not master, in connection with his course in surveying. This work should include the measurement of angles by repetition, the effect of a reversal of the instrument in eliminating its errors, the method of employing its plate and striding levels, and the mode of eliminating the effect of graduation errors. If an instrument with micrometer microscopes is available, instruction in its use may be given at this point and the instrument first employed for measuring the zenith distance of a terrestrial mark. It is advantageous to throw the alidade level somewhat out of adjustment, in order to impress upon the student that the reversal of the instrument eliminates all defects of this kind from the measured zenith distance.

Although not strictly germane to a course in astronomy, the subject of trigonometric levelling with the effect of refraction and the curvature of the earth's surface may be introduced here with advantage.

In his measurements of zenith distance the student should be taught to bring the level bubble somewhere near the middle of its scale, but not be allowed to spend much time in getting a nice adjustment of it, reading the level and subsequently applying its indications as a correction to the circle readings. This requires a knowledge of the value of a level division, and the student should be required to determine this value by whatever method his instructor deems most convenient.

Passing on to astronomical uses of the

theodolite, the student may determine latitude from circum-meridian altitudes of the sun (Gauss' mode of reduction) and azimuth from simultaneous readings of the vertical and horizontal circles when the line of sight is directed to the sun, combined with readings of the horizontal circle when the telescope is directed upon a terrestrial mark. This mode of determining azimuth, although very much neglected in the text-books, admits of considerable precision and is excellently adapted to the purposes of the engineer.

Thus far the student's problems have involved only work by daylight, but he should now take up night work and will require some instruction about illuminating the wires of his instrument and in reading verniers, levels, etc., by lamplight. His first problem should be the simultaneous determination of time and latitude from equal altitudes of Polaris and southern stars. This method is very little used in America, but it is the best method of using an engineer's transit for the determination of either time or latitude and should be taught to engineers. An exposition of the method with examples of its application has been given by the author of this paper in the Bulletin of the University of Wisconsin, Science Series, Vol. I., No. 3.

An average student with a good transit and ordinary watch may be expected within an hour to determine his latitude within 2″ and the error of his watch within a quarter of a second.

The limits of time above allotted permit the assignment of only one more problem in our course, the determination of azimuth from observations of a close circum-polar star. The student should be taught that while it is advantageous to observe at elongation it is by no means necessary to do so, and that by a proper combination of stars, together with an approximate determination of time, he may frequently avoid the necessity of observing at inconvenient hours without in any way impairing the precision of his results.

In outlining the above required course, to be given in sixty exercises, or less, no reference has been made to a text-book, and the author knows of no text-book which is altogether satisfactory. In giving at the University of Wisconsin the equivalent of the course above outlined it has been his practice to prepare cyclo-style copies of lecture notes covering the ground to be traversed by the class and including in detail the record and reduction of a set of observations corresponding to each problem assigned the student. A copy of these notes is placed in the hands of each student and he is expected to familiarize himself with the text contained in them and to use the numerical parts as models for the record and reduction of his own observations. These observations and their reduction written up in a note-book and accompanied by the requisite formulæ are preserved by the student as guides for any future work of the kind which he may have occasion to do. This mode of instruction, however, cannot be regarded as altogether satisfactory, and a suitable text-book would presumably strengthen the course.

It does not fall within the scope of this paper to provide in detail an advanced elective course in astronomy. As our schools are organized such a course must be arranged to meet the requirements of each individual case, but the material available for such a course in a properly equipped engineering observatory may be indicated as follows:

The Transit Instrument. Determination of time in the meridian. Investigation of the constants of the instrument. Determination of azimuth by mounting the instrument in the vertical of a circum-polar star near elongation.

Clocks and Chronometers. Comparison

of. Investigation of rates and temperature coefficients.

The Zenith Telescope. Investigation of constants. Determination of latitude.

The Universal Instrument. Refined determination of azimuth. Latitude from altitudes of stars. Time from transits over the vertical circle of Polaris, Doellen's method.

Transit Instrument in the Prime Vertical. Determination of latitude and declinations of stars.

The prosecution of such a course of study necessarily implies a considerable addition to the student's theoretical knowledge, and concurrently with his instrumental work he should take up in the standard treatises such subjects as precession, nutation, aberration, refraction, the reduction of star places, etc.; but we here approach, if indeed we have not already passed, the bounds which separate engineering study from the domain of the professional astronomer.

The points at which the writer of this paper seeks to place special stress are that a brief course in spherical and practical astronomy is properly a part of the professional training of every engineer in whose work surveying is to occupy an important place, and that this instruction can be advantageously given with no further instrumental equipment than that possessed by every good school of engineering.

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HOW FAR SHALL THE PERIODIC LAW BE FOLLOWED IN TEACHING CHEMISTRY?

More than a quarter of a century has passed since Mendeleeff announced the Periodic Law. Any one who critically surveys this period will be forced to admit that this discovery has been the most fruitful of results of any since the Atomic Theory, and I believe we are just beginning to realize the value of this Natural Law and to have some idea of the fulness of its true meaning.

Chemists have shown themselves very conservative in the adoption of such discoveries and the ordering of their science by means of them, but it seems that in this case they have carried their conservatism too far. And perhaps this conservatism has not always been that which springs from a careful guarding against the possibly false and misleading, but rather from mental inertia and a dislike of giving up the old and learning the new.

The Natural Law, if true, introduces some most radical changes into the science. It is in a measure subversive of the old. It is impossible to cling to the old system while ascribing high praise to the Periodic Law, as is done in so many of our text-books.

If this law is true it must dominate all of chemistry. Its statements are fundamental and all-embracing. It cannot consent to share its authority with the old system. There can be no half-way measures. Just in so far as it is accepted as proved it must be incorporated into the science. The custom has been to teach chemistry to beginners very much in the old style, and then to give a short time to explaining the Periodic Law, instead of teaching the science with this as the very foundation.

It is manifestly the duty of a conscientious teacher to satisfy himself as to how far this law is true, and then to make all possible use of it in his teaching, as he does of the Atomic Theory itself. If it is false reject it, if true let it be the foundation of your system of instruction.

Now let me say, at the beginning, that for myself, I regard this law as incomplete in several of its details. But some points of prime importance may be regarded as settled.

1. That the elements are not distinct and separate individuals, but are more or less

closely related and must be treated in some measure as we treat the hydrocarbons. The degree and nature of the relationship is as yet unkown.

This idea of the inter-relationship of the elements must be at the bottom of all teaching of the science. I do not think it possible in the present state of our knowledge to lay very much stress upon that which is called periodicity, nor yet upon the degree of relationship as expressed by the atomic weight differences.

If too much stress is laid upon them in their incomplete state they may bring into doubt the great truths of the law.

2. The old division into metals and non-metals, or metalloids, is no longer permissible. It was always most arbitrary and indefensible, except on the grounds of convenience. It is no longer convenient, and being a false distinction it serves only to obscure the truth. I think some of the hesitation in accepting the Periodic Law has been due to the false ideas springing from this old-time division.

There is no such clear-cut division between the elements.

It would be contrary to the fundamental idea of their kinship. They must be taught by groups and the gradation of positive to negative tendencies pointed out along with the change of atomic weight and of valence.

3. It is clear that, if these elements are related and show a certain gradation in properties and the old idea of their separate and distinct individuality is to be given up, then the proper classification for the salts is under the head of the acid which mainly determines their nature and not, as in the old way of teaching, under the head of each metal. Mineralogists long ago seized upon this as the simplest and most natural way of classifying minerals, but chemists have been slow to catch the idea. I can assure my fellow teachers, from my own experience, that time is saved, the subject made clearer and the tax upon the memory lessened by this simple change of classification.

4. Valence and the gradations in it must be taught according to the natural arrangement. We cannot stand back because confronted with something which we cannot explain. Many of the facts of the science must be taught as facts leaving the explanation to those who are to follow us and to whom many of the things which are mysteries to us will be made plain.

It is just as well for the chemist of to-day to acknowledge that with all of the progress, of which he is justly proud, he is really only on the threshold of his science and that he is surrounded by the unknown on every side. What does he know of chemical force itself, of the nature of the atoms, of the character of this wonderful relationship, of valence and of many other problems?

I do not think the beginner should be tried too much with discussions of these problems nor with attempted explanations.

Such explanations are too subject to change. As to periodicity, I question the advisability of laying too much stress upon this feature of the Mendeleeff System in teaching Elementary Chemistry. It is true that the author makes this the first one of the eight conclusions drawn from his System but he speaks of it as an 'evident periodicity.' Every chemist who has examined into the matter will admit evidences of periodicity, but as the periods are irregular and not fully agreed upon, as the character of the periodicity varies and is unexplained, it is not wise, I repeat, to lay too much stress upon this feature yet awhile. The recurrence of elements of the same properties, that is periodicity, must be mentioned, but I would prefer to impress all this in a general way as a dependence of the properties upon the atomic weights. Still, I think, this is largely a personal matter. I do not like to teach with too

much dogmatism to young students half-discovered truths.

5. The system gives us certain typical elements. From these can be deduced the properties for the various members of the groups, and their treatment is greatly simplified. The old division into families, which was partial only, is broadened and filled out in the new groups.

6. I freely acknowledge that there are difficulties to be met. How could we expect it to be all plain sailing where our knowledge is so incomplete and that which we suppose we know is often so inaccurate. It is sometimes difficult to assign an element to its proper group and one is especially troubled by what Blanshard has called 'Cross-Analogies.'

I believe the atomic weight is to be accepted as the final arbiter of arrangement in all cases.

I have prepared a table in which what I have regarded as the most prominent facts of the Natural System are presented.

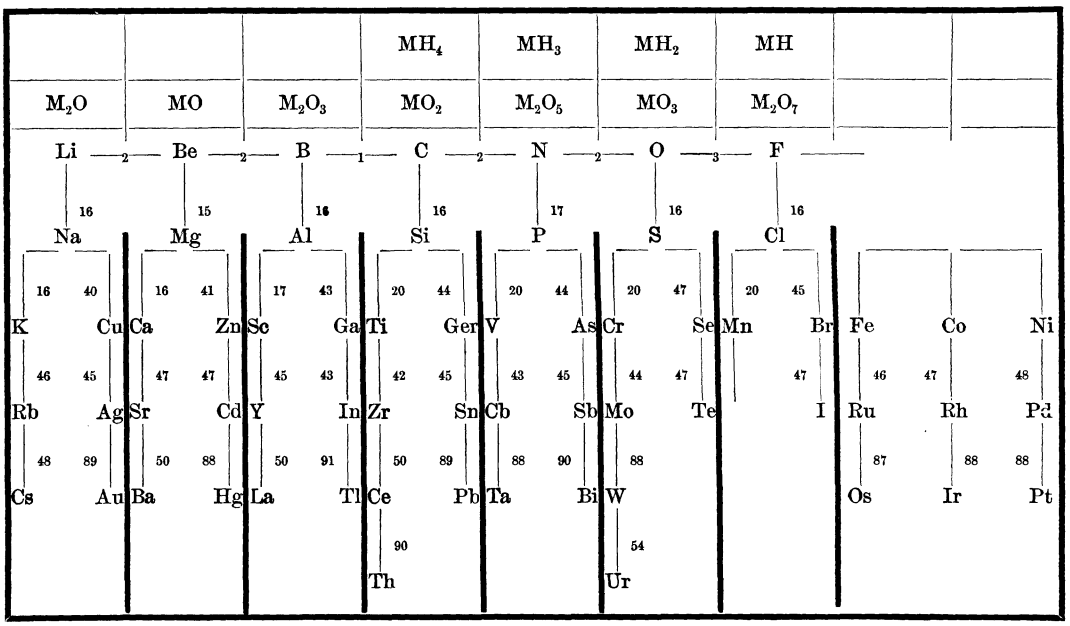
I offer this only as possessing the value of success under personal trial.

I do not propose it as something free from objections, but merely as the best that I have been able to think out. I hope to improve it on further trial, and I trust that others will see and suggest improvements. The table was printed in the American Chemical Society's Journal for January, 1895.

My method, following Lothar Meyer's notable lecture before the German Chemical Society, is to preface the course with a discussion of water as a compound, air as a mixture, and the component elements. This gives the three classes of elements, compounds and mixtures, and some opportunity for fundamental laws. Then the table is given and its working explained.

All of the elements are then described in their proper order.

Then their hydrogen compounds, followed by the oxygen compounds. As each acid-forming oxide is reached, its salts with all the bases are given and described.



The system is simpler, clearer, saves repetition and time (five months instead of six and a half), is less burdensome to the memory, and gives a fairly uniform system for inorganic and organic chemistry. This in itself is an advantage not to be lightly estimated.

The table is not to be pushed too far—one must be careful not to go to lengths incapable of direct proof. The position in which the elements fall should not be used as having any reference to their genesis, derivation or composition.

As to graphic representations of the Natural System, I have examined all and rejected all as unsuited to teaching the science. All are open to the serious objection of carrying analogies too far, and leading the student on to deductions and dreams for which the chemist of to-day has no possible proof.

Take for example the pendulum oscillations of Spring and Reynolds, inseparably connected now with Crookes' speculation as to the Genesis of the Elements or take Preyer's condensation-steps and generation pyramids, all full of this idea of the genesis. Mendeleeff dismisses the idea of such curves of properties as Meyer devised, and there is much weight in his criticisms. Such curves are, at any rate, instructive only to those who are capable of reading mathematics critically.

I would counsel the use of the simple table without the questionable aid of curves or diagrams of any kind.

The summing up of the whole matter is this: If the Natural System is true it cannot be relegated to a side place in your teaching. It forms the basis of your entire course, and unless you utilize it you are occupying a false possition and depriving yourself of the most valuable aid which the teacher of to-day has at his command.

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THE STATUS OF THE SOLAR MAGNETIC PROBLEM.

A SERIES of papers has been published in different journals during the past four years giving a very brief account of the steps taken in the investigation of the general problem of the transference of energy from the Sun to the Earth. It is probable that the main thread of the argument may be obscure to some readers for want of a consecutive statement of the case, and it is therefore proposed to summarize the evidence already obtained, as well as to indicate the nature of the scientific questions immediately at hand.

The research has been one of peculiar difficulty to successfully prosecute to definite conclusions, not because the line of operations was obscure, nor on account of the intricate mathematical conditions, but chiefly in consequence of the looseness of the phenomenon under consideration. By looseness is meant the wide deviations from the normal laws, whatever these may be, arising from the actual spasmodic actions of the sun on the one hand, and the very indirect effect of the solar energy thus generated upon the terrestrial, magnetic and meteorological fields, as recorded by the instruments employed in observations. This is an ordinary difficulty when the ether is the medium of the transference of energy between masses of matter widely separated in space, and in our case it is especially complex by reason of the complicated nature of the transmitter and the receiver, namely, the sun and the earth respectively. The solution of the problem must necessarily be by a system of approximations, in which unknown terms are carried hidden in the residuals during one operation, until the result obtained enables a repetition of the work under clearer conceptions. Also the complication of terms is so great that it is only by the successful treatment of an enormous mass of material that the im-

pressed force desired will emerge by the mutual destruction of other terms. Hence the work is laborious and the residuals small at the end of the first trip through the observations.

To obtain any result whatever it has been necessary to adhere closely to certain precepts, and also it has been requisite to learn to look beneath the apparent discordances of curves which purported, but on the surface seemed not, to be a record of the same fundamental pulsation. It was very natural that those who seek to verify the results of an investigator should expect to do so with a brief treatment of the material involved, and it could be easily shown that certain criticisms which have been published were based upon this process. Some highly discordant curves are shown as arguments against the truth of my conclusions, but in every case so far as known some of the precepts were violated and only a little material was used. Negative results to be valid against positive must be at least as exhaustive, both as to the concepts employed and the amount of material in evidence. In publishing conclusions it has been my practice to retain partially tested work till such advance had taken place as to become a pretty sure criticism of the results communicated, and it has therefore been regarded as conducive to the progress of the research not to complicate it with discussions of the negative arguments, which were obviously violating certain precise rules of procedure as yet unexplained to the public.

The ultimate goal of interest to the Weather Bureau is the improvement of the forecasts, whether in reading the daily maps or in predicting seasonal conditions for a year or more. Meteorology had contented itself with combinations of three forces, the earth's gravitation, the earth's rotation and equatorial insolation, acting upon the fluid atmosphere, in order to explain the observed effects in the motions of the air. The result has not satisfied students of the subject. The first point to determine was whether the sun did or did not transmit other energy to the earth, and, if it did, what kind of energy. The probability was that the auroras, the magnetic storms and earth currents, certain spasmodic actions in the electricity and magnetism of the earth's field and motions of the atmosphere, the sun spots and the coronal output, all belonged to one fundamental system, though no intelligible notion had been proposed that could explain the interrelation philosophically. The great distance of the earth from the sun seemed a barrier to one obvious explanation, so that the work was never seriously undertaken to test the validity of it.

My own attempts to solve the question of the meaning of the stream lines seen in the corona during an eclipse of the sun suggested and strengthened the working hypothesis that the whole unexplained system might be referred to the sun as a magnet in dynamic operation, and that live lines of magnetic force originating in the sun were propagated to the earth in wide sweeping curves, where the energy was expended in various operations, such as those just mentioned. Progress was also made in computing and mapping out the system of forces causing the diurnal and annual swings of the magnetic needles, which showed plainly that a complex field of mechanical forces besides gravitation surrounded the earth at its surface. Such forces must necessarily be referred to the electro-magnetic radiation of the sun, because the system was instantaneous and observations covering half a century could be combined without reduction for secular variation; and also because the entire system wanders up and down the earth with the change of the position of the axis of the field, as the sun moves in declination.

Furthermore, the fact that this field exhibits three compensating couples, fulfilling the laws of refraction when a permeable shell is placed within an external magnetic field, renders it certain that we have at last secured the basis of the complete solution of the ancient problem of the distribution of the earth's *quasi* permanent magnetism and its variation in short and long periods.

In order to distinguish the field of force that was supposed to produce the aurora and the other phenomena above mentioned, it was proposed to call it 'coronal,' or 'polar' radiation, in distinction from the sunlight, or equatorial radiation. It is radiation of some kind, if there is any transmission of energy through the ether from the sun to the earth, and it may be simply magnetic, or curved radiations, as opposed to rectilinear, or electro-magnetic radiation, the latter having been practically established as natural by the work of Maxwell and Hertz.

It was evident that if a solar-polar magnetic field existed and extended to the distance of the earth, its presence would be revealed by periodic variations, the period being determined by the synodic rotation of the sun, and the variations by the impressed energy due to the magnetic output on the several meridians. Also for the maintenance of such a normal field, whatever fluctuations it might undergo in itself, it was necessary to suppose that the nucleus of the sun is to some extent rigid, or at least non-vaporous. The detection of the synodic period and the approximate form of the curve representing the solar field at the distance of the earth followed, the period being 26.67-928 days, and the curve the one many times published. The period was found from the years 1878 to 1889, these containing the available European modern observations; since that time an application of the same period carried back from the epoch 1887 to the British Colonial Stations, 1841 to 1848, gives back the same curve, as if begun about one-tenth of a day later. Thus my first period is sufficient for a half century's work, and it is plain that a rediscussion of all the data will enable us to determine the rotation of the sun with extreme accuracy. Since we recognize the fact that the magnetic curves are a true and delicate register of solar action through at least 800 revolutions, it is clear that few natural phenomena have been so continously recorded as the solar motion and in such detail. The same remark applies to the other physical manifestations of the energy of solar nucleus, if we learn to correctly interpret the changes in the magnetic curves. This unconscious contribution to solar physics by magneticians, through more than fifty years, is abundant justification of the faith in science that has inspired their work, and a sufficient answer to the cavilling question, *cui bono*.

The securing of the solar period was, of course, the foundation of progress in the classification of large masses of hitherto unworkable data. The illustration of its power is contained in the series of results thrust upon us by using it. At first the effort was made to detect a similar curve in meteorological and in solar phenomena by simply massing the observations in this period. The results were tantalizing, if not discouraging, for, while it was evident that a similar synchronous beat existed in the atmospheric elements, yet the residuals were so small, and the curves exhibiting them so rough, when compared with one another, that it seemed for a long while as if further progress might be impossible. However, by persistent study of successive periods during which no little practical skill was developed in detecting the underlying harmony in apparently unrelated curves, it was discovered that the normal curve was subject to inversion. That is to say, the curve was workable for a season, say a few weeks,

or even four months in one position, and then the system conformed to the same curve if inverted. The explanation of this singular and apparently irrational phenomenon was not found for a long while, although the fact that it existed could not be doubted. The mode or law of this inversion is yet a subject of study, and its great irregularity makes it difficult to thoroughly understand.

It was now seen that the result of massing all the observations on one period was to give back very small residuals, which expressed merely the excess of the strength or the energy of one system over the other. Two large inverse types may thus give exceedingly small residuals, if they are nearly equally balanced in power. The form of the curve at first obtained was also partially defective for the same reason, three minor crests being suppressed in the magnetic field. On applying the clue thus obtained to the temperatures of the northwestern districts of the United States the two types emerged unmistakably, and also a curve more precisely representing the normal solar field. Now on reviewing each period of the European magnetic field with this improved curve it was comparatively simple to separate all the observed vectors into two parts corresponding to the direct and the inverse types. Thus the residuals were greatly improved, the forms of the curves steadied, and in every sense the future of the problem greatly strengthened. The critical elements at the earth, the magnetic field and the meteorological temperatures and pressures in the northwest, all agreed in classification under the same double system, and in producing curves that are merely the inverse of one another.

It next became extremely important to discover some simple, rational cause for this peculiar inversion, so persistent for years and so universal on the earth. In the magnetic field it is common simultaneously to all stations in the northern and the southern hemispheres, in whatsoever longitude. In the meteorological system the principal center of concentration is in the northwest of the American Continent, so far as explored; other centers of action will doubtless be detected. Supposing the seat of inversion to be in the solar action, it was proper to classify the sun-spot areas in two groups, keeping the northern and the southern hemispheres independent of each other, by massing these respectively on this period. The result is very gratifying, for they give back the same fundamental curve, the southern hemisphere corresponding to the direct type, and the northern to the inverse type. This fact may well be regarded as the keystone to our arch, as it gives stability to the entire structure of the research. We must conclude that the sun emits two types of magnetic energy, whose products, to some extent, are the coronal stream lines and the sun-spot system, and probably other phenomena on the sun; while on the earth is to be found the same periodic function displayed in the variations of the magnetic field, and the American meteorological system certainly, acting continuously through the curved lines of magnetic force; spasmodic action within the solar nucleus gives the auroral display, the magnetic storms and electric currents, and possibly other important effects.

On the sun the minor results are the proof that the solar nucleus rotates with very nearly the same motion as the visible equator; the center of the coronal belt is in latitude $\pm 55°$; the sun spots drift anti-rotationally, and by comparison in this period all surface currents can be detected and analyzed in longitude as well as in latitude; the density of the sun must be greatly modified by reason of a distribution of matter into a nucleus and a distant en-

velope or photosphere. On the earth it has been shown that the permeable magnetic material is confined to a shell about 800 miles thick; that in consequence of this the external field divides into an exflected system, accounting for the location and movement of the auroral belt, and an inflected system, in some way related to the energy of tropical hurricanes; that the lacking term needed to account for the spasmodic action of storm generation over our entire hemisphere is to be attributed to the solar field; that the storm tracks of the United States vary in latitude and the eastward drift of storms in longitude, also the temperature annual means and amplitudes with the solar field in the 11-year period; that the storms are formed in the northwest in a procession corresponding to the type prevailing, and that this order is inverted with the type; that the maximum of extra-tropical storms of America, as compared with Siberia, is due to the impression of this variable energy upon the atmosphere in North America; that the prevalence of storms and cold waves in winter is due to the increased action of the magnetic field at lower temperatures; that the glacial epochs may naturally be referred to the long period variations of the sun as respects its magnetic output; that the observed minute variations of terrestrial latitudes may be plausibly ascribed to the action of the stresses in the ether at the surface of the earth, due to the mechanical forces generated in the ether by the transmission of radiant energy.

It is evident that, besides the very practical results to forecasting to be expected from a complete solution of the problem of storm generation in this long period of 26.68 days, we have a large field of study in the relations of magnetism and electricity. If all radiant energy is accompanied by vector stresses in the ether, of the minute amount disclosed by the residuals, it may not be impossible that gravitation is an ether stress generated by the atomic vibrations of ponderable matter, spreading in spherical waves through space, according to the Newtonian law. The fact that the sun's hemispheres exhibit the normal field inverted in them respectively, by which a maximum in one corresponds to a minimum in the other on the same meridian, leads one to doubt that a continuous line of force, as assumed in theory, passes from the positive to the negative pole. At any rate here is an exhibition of what a dynamic magnet is actually doing, our experiments heretofore having been confined to static conditions. The mode of transference of this magnetic energy through the ether is wholly unknown, and its solution must greatly enlighten us upon several important subjects.

This research has been greatly handicapped because no magnetic observations have ever been made in the northern Rocky Mountain regions of the United States, where the interrelation of several primary physical forces can be most successfully studied. The high altitude of this region, bringing the stratum of the atmosphere in which observations are made more nearly into contact with the external field, and its proximity to the polar magnetic cap, suggest that it is the most appropriate place for the establishment of a magnificent permanent solar-terrestrial observatory, equipped with the best instruments available, and managed by men of power in scientific investigations. One such observatory in the Northwest and another in the eastern part of the United States, together with some minor stations, would no doubt amply repay the American people for the expense of equipping and maintaining them through the agency of the Government.

FRANK H. BIGELOW.

WASHINGTON, D. C.

CURRENT NOTES ON PHYSIOGRAPHY (XVI.).

RUSSELL'S LAKES OF NORTH AMERICA.*

Professor Russell calls his new book 'a reading lesson for students of geography and geology.' It is appropriately dedicated to Gilbert. An opening chapter discusses the origin of lake basins, a subject which the author's own studies in the West have greatly advanced; for we owe to Russell not only the best account of a region of comparatively recent dislocations, where lakes lie in the relatively depressed areas, but also the description of such lacustrine curiosities as Moses Lake, in Washington, retained in a deep valley behind a barrier of sand dunes, and such as the two lakes that lie in basins formed by the plunge of a cataract on the temporary glacial course of the Columbia. Other chapters concern the movements of lake waters and the geological and climatic functions of lakes. The topography of lake shores is particularly well illustrated, chiefly by plates selected from publications of the U. S. Geological Survey, now placed more conveniently in the hands of teachers and students. The relations of lakes to climatic conditions, the resultant composition of their waters and the variation of their volume are fully considered. The book closes with an excellent account of certain special lacustral histories, including the pleistocene lakes of the Laurentian basin, Lake Agassiz, the pleistocene lakes of the Great Basin and certain lakes of the more remote past. If this book has the circulation that it deserves, the rising generation of geographers will greatly profit by it.

A SEICHE IN LAKE SUPERIOR.

A class of movements of lake waters, briefly treated in Russell's book, is the 'seiche,' or slow oscillation of level, long known and minutely studied in Switzerland, especially by Forel; vaguely recorded and hardly studied at all in this country. A strong seiche was observed in Chequamegon Bay, near the west end of Lake Superior, on September 11, last. It rose in a 'wall of water' about four feet high, extending across the bay and rushing in upon the low shore, where it did much damage, lifting up the logs of corduroy roads, breaking log booms and drifting the logs away, and even putting out the fires under a few steam boilers. The water gradually subsided, bearing back to the lake a confused flotsam of 'roots, grass, tree tops and other debris.' Mr. G. M. Burnham, of the Ashland (Wis.) *Daily Press*, calls my attention to the occurrence at Harbor Springs, near the north end of Lake Michigan, also on September 11, of a gradual depression of the water 'fully five feet,' followed by a gradual rise, and other minor changes of level. Although these peculiar disturbances are sometimes strong enough to break boats away from their moorings, and although the automatic records of water levels maintained by the army engineers at various lake ports show minor seiches of almost continual occurrence, no serious study of their varied phenomena has yet been undertaken.

BATHYMETRY OF THE ENGLISH LAKES.

Dr. H. R. Mill describes his bathymetrical survey of the English lakes in the July and August numbers of the (London) *Geographical Journal*, with many illustrations from photographs and an excellent series of tinted maps by Bartholomew. The view of Wastwater is a particularly good illustration of a lake in its hill-setting; not simply a sheet of water bounded by a distant shore, such as appears in most pictures of lakes. The following table presents a number of the results gained:

*Ginn & Co., Boston, 1895, 125 pages, with numerous illustrations. Price, $1.65.

Lake.	Length. miles.	Area, sq. m.	Elevation.	Depth.	
				Max.	Mean.
Windermere.	10.50	5.69	130	219	78½
Ullswater.	7.35	3.44	476	205	83
Wastwater, ...	3.00	1.12	200	258	134½
Coniston Water....	5.41	1.89	143	184	79
Crummock Water.	2.50	0.97	321	144	87½
Ennerdale Water..	2.40	1.12	368	148	62
Bassenthwaite	3.83	2.06	223	70	18
Derwentwater	2.87	2.06	244	72	18
Haweswater.....	2.33	0.54	694	103	39½
Buttermere	1.26	0.36	329	91	54½

Derwentwater and Bassenthwaite belong together as a shallow lake, divided by an alluvial flat; their average depth being only 18 feet, and this average being only a quarter of their maximum depth. The other lakes form a deeper group, whose average depth is 40 feet, while the average depth of each one varies from 36 to 61 per cent. of its maximum depth. The best examples of this class lie in long narrow valleys with steeply sloping sides, the slopes being continued under water and terminating on a flat bottom. The lakes as a whole reach just as far as and no farther than the beginning of the more level country which skirts around the highland.

DIURNAL VARIATION OF RIVER VOLUME AND VELOCITY.

PROFESSOR BRÜCKNER, of Berne, contributes a review of numerous observations on the rivers of Switzerland to Petermann's *Mitteilungen* (June and July, 1895,) which result in showing that all the streams heading in regions of melting snow or ice have perceptible diurnal fluctuations in volume and velocity. These are noticeable in the Arve to the city of Geneva, the Rhone to its mouth in Lake Geneva, the Aar to Lake Brienz, the Reuss to Lake Lucerne, especially in midsummer; the wave of high water advances down stream at a rate of three or four meters a second. Side streams entering a trunk river at different points tend to confuse the high water wave, but fail to obliterate it. While a particle of ice requires decidedly more than a century to move from the summit of the Jungfrau to the foot of the Aletsch glacier, 29 km., only twelve hours are needed for the water to flow from the glacier down the Rhone to Lake Geneva, where it remains on the average about eleven years before resuming its journey to the Mediterranean.

GEOGRAPHY IN NORMAL SCHOOLS.*

TEACHERS of geography in normal schools will do well to consider Mr. Murdock's plan of work at Bridgewater; not so much because it can be immediately applied elsewhere as because of the importance that it attaches to local observation in geographical study, and because of the large share of attention allowed to questions of origin, structure, denudation and the like, which are too often left to one side, as if fenced off in a geological field where the geographer must not trespass. Many references are made to good materials. On the other hand, the fault of too much method, thought by many educators to be characteristic of normal schoools, occasionally appears; as in such a definition as "A picture of an object is the representation on a surface of the appearance of an object." Any scholar in a normal school who needs this definition cannot be ready for serious geographical study. So sententious a truism as "Geographical objects within the range of vision must be observed; the product of of the observation is knowledge," is another sign of those normal school methods in which a diluted psychology is mixed with other subjects of study, to the distress and embarrassment of the everyday teacher.

W. M. DAVIS.

HARVARD UNIVERSITY.

* *Outline of Elementary Geography.* By F. F. Murdock, State Normal School, Bridgewater, Mass. Revised edition. July, 1895. pp. 159.

SCIENTIFIC NOTES AND NEWS.

THE IPSWICH MEETING OF THE BRITISH ASSOCIATION.

The address of the president, Sir Douglas Galton, already printed in this journal, attempted the difficult task of reviewing the progress of science during the sixty years that have elapsed since the foundation of the Association. His long service as secretary made him especially familiar with those scientific advances to which the Association has directly or indirectly contributed. Prof. W. M. Hicks, president of Section A (physics), reviewed recent attempts to explain the ultimate nature of matter. Prof. Raphael Meldola, president of Section B (chemistry), reviewed the great progress made by the science since the previous Ipswich meeting in 1851. The address of Mr. W. Whitaker, president of Section C (geology), is reported in the present number of Science. Prof. W. A. Herdman, president of Section D (zoölogy), dealt almost entirely with questions of marine zoölogy. Mr. H. J. Mackinder, president of Section E (geography), and Mr. L. L. Price, president of Section F (economics), reviewed recent developments in their respective departments. Mr. L. F. Vernon-Harcourt discussed the relation of engineering to science with special reference to mathematics and chemistry. The address of Prof. Flinders Petrie, president of Section H (anthropology), on interference with lower civilizations has been widely quoted in the daily papers. In Section K (botany) the president, Mr. W. T. Thiselton-Dyer, gave an account of Henslow in his relations to Darwin, and compared the old natural history and the present laboratory methods in botany.

The scientific papers presented before the several sections were numerous and interesting, but it is difficult to select any for special notice. Lord Rayleigh, who the year before announced the discovery of argon, described minute investigations into the refractive indices and viscosities of argon and helium, and Professor Runge, of Hanover, communicated the results of experiments, showing that the gas from cleveite is made up of two constituents, of which one is always present in the sun, and the other only occasionally and proposed that the name helium should be restricted to the former. The interpretation of the results obtained with the spectroscope was discussed by Prof. Schuster and Dr. G. J. Stoney. Two of the most important papers presented before the Association, that on the 'Electrification of Air' by Lord Kelvin, Mr. Maclean and Mr. Galt, and that on 'Oysters and Typhoid' by Professors Boyce and Herdman have been contributed by the authors to this journal.

The attendance at the Ipswich meeting was the smallest since 1880, the total number of members present being 1,234. This is, however, nearly double the number that attended a previous meeting held in this town in 1851, and bears witness to the increasing size and influence of the Association. According to the report of Professor Rücker, general treasurer, the receipts for 1894–95 were £4,214; £1,160 was appropriated by the committee for scientific purposes and distributed among the different sections as follows: Mathematics and Physics, £245; Chemistry, £80; Geology, £140; Zoölogy, £405; Geography, £10; Mechanical Science, £40; Anthropology, £180; Physiology, £25; for the report of the Corresponding Societies, £30. Sir Douglas Galton resigned the general secretaryship of the Association, a position which he has held for more than twenty-four years. Professor E. A. Schäfer was elected his successor. The next meeting of the Association will be held at Liverpool, commencing

on Wednesday, September 16, 1896, under the presidency of Sir Joseph Lister. Toronto was selected for the place of meeting in 1897. An invitation from Bournemouth has been received for the year 1898, and an invitation from Dublin is expected for the same year.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

THE prospectus of the Brooklyn Academy of Arts and Sciences for 1895–96 has been recently issued. It gives preliminary announcements of the courses of instruction, lectures, exhibitions and entertainments planned for the ensuing year. A number of well known specialists from other institutions have been invited to lecture during the year, and many of these have already consented.

Six illustrated lectures in astronomy may be mentioned as of special interest. Mr. Percival Lowell has been invited to lecture on 'The Planet Mars,' Professor Henry A. Newton on 'Meteors,' Professor Edward E. Frost on 'Stellar Spectroscopy,' Professor James E. Keeler on 'The Methods of Astro-Physical Research with Special Reference to Saturn's Rings,' Mr. Wallace Gould Levison on 'Radiant Matter,' and Mr. John A. Brashear on 'The Evolution of a Telescope, or the Story of an Astronomical Object Glass.' In the department of Domestic Science Professor John S. Billings will lecture on 'The Diseases of Occupations,' and Professor R. H. Chittenden on 'The Value of Meats as Food.' The names of Mr. William Kent, Professor R. H. Thurston and Professor Frederick R. Hutton appear in the list of lecturers in the department of Engineering. The Geological department is particularly strong, lectures being announced on the first Monday evening of each month by President T. C. Mendenhall, Professor R. S. Woodward, Dr. Charles D. Walcott, Dr. Joseph F. James, Professor Charles S. Prosser, Dr. W J McGee, Professor W. M. Davis and Professor D. S. Martin. Professor Woodward will also deliver a course of lectures in the Mathematical department. Professor William O. Crosby, Professor Samuel L. Penfield, Dr. W J McGee and Professor A. J. Moses are announced to lecture in the Mineralogical department. In psychology Professor William James will deliver a course of six lectures on 'Recent Researches into Exceptional Mental Phenomena,' and Professor G. T. Ladd a course of six lectures on hypnotism from the physiological and psychological points of view. It is hoped that Professor E. D. Cope and Professor E. B. Wilson will lecture in the Zöological department.

Further information concerning the Institute and the terms of membership may be obtained from the Director, Professor Franklin W. Hooper, 502 Fulton Street, Brooklyn.

GENERAL.

PROFESSOR RAMSAY writes to *Nature* that he has received a letter from Prof. Olszewski, of Krakau, in which he informs him that having exposed a sample of helium which he sent him to the same treatment as was successful in liquefying hydrogen—namely, compressing with a pressure of 140 atmospheres, cooling to the temperature of air boiling at low pressure, and then expanding suddenly—he has been unable to detect any sign of liquefaction. The density of helium being, roughly speaking, twice that of hydrogen, it is very striking that its liquefying point should lie below that of hydrogen. It may be remembered that argon, which has a higher density than oxygen, liquefies at a lower temperature than oxygen; and it was pointed out by Prof. Olszewski that this behavior was not improbably connected with its appar-

ently simple molecular constitution. The similar fact now recorded for helium may therefore be regarded as evidence of its simple molecular constitution.

The directors of New York Botanic Garden, to be laid out at Bronx Park, have formally accepted the allotment of 250 acres in Bronx Park, with the restrictions relating to the cutting down of trees in Hemlock Grove, and voted to request the Park Department to secure from the city the $500,000 appropriated in the act of incorporation in case $250,000 was raised by private subscription. The entire $250,000 has been subscribed in amounts of $25,000, and a large part of the sum has already been paid in. The gardens are to be left so far as possible in their natural condition.

According to the returns issued on the present state of cholera in Russia, there occurred during the last fortnight of September in the province of Podolia 51 cases and 19 deaths from the disease, and in the province of Volhynia 7,827 cases and 3,085 deaths.

The Committee on Terrestrial Magnetism of the British Association presented at the Ipswich meeting an elaborate analysis of a series of observations made with the magnetographs at Kew Observatory by the recently appointed Director, Dr. Chree.

Macmillan & Co. have issued the first number of a quarterly journal, *The American Historical Review*. Six of the leading American historical scholars constitute a board of editors, and Professor J. Franklin Jameson, of Brown University, is managing editor. The number contains 208 large octavo pages, and maintains throughout a high standard of scientific scholarship.

Mr. J. Gray read a paper before Section H, of the British Association, upon anthropometric observations in East Aberdeenshire, which pointed to the existence in Aberdeenshire (1) of a Germanic or Canstadt type, fair-haired, with light eyes, concave nose, and an average height of 5 ft., 7 in.; (2) of an Iberian or Cro-Magnon type, dark-haired, dark-eyed, aquiline-nosed, and of an average height of 5 ft., 11½ in.; and (3) of a broad-headed type, dark-haired, dark-eyed, probably straight-nosed, with an average height of 5 ft., 4 in.

The issue of the *British Medical Journal* for October 5th states that the lines inscribed on Huxley's tombstone, and quoted in the last number of Science, are part of a poem by Mrs. Huxley, and were used as Huxley's epitaph at his own request.

Mr. W. J. L. Warton states in *Nature* that a deeper spot in the ocean than any yet known has been recently found by H. M. surveying ship *Penguin*. Unfortunately the observation was not complete, as a fault in the wire caused it to break when 4,900 fathoms had run out without bottom having been reached. This occurred in lat. 23° 40′ S., long. 175° 10′ W., about 60 miles north of a sounding of 4,428 fathoms obtained by Captain Aldrich in 1888. As the deepest cast hitherto obtained is one of 4,655 fathoms near Japan, it is at any rate certain that the depths at the position named is at least 245 fathoms greater.

It is stated that Professor Joly has sold the right to his process of color photography for the United States and Canada to Mr. Schuyler, of New York, for $30,000. He is negotiating for the sale of the right to the process for other countries, and the invention is patented for England.

The third annual convention of the National Society of Electro-therapeutists met at Boston on Wednesday, the 17th and 18th of September, under the presidency of Dr. Wm. L. Jackson. In speaking of recent advances in the applications of electricity to therapeutics, the president said: "Already electricity has a wide sphere of usefulness. Even its physical properties, as heat and

light, assist us. By means of its light, we obtain a knowledge of internal organs and parts by which we are enabled to treat them far more satisfactorily than we could without its aid. It has been proved that the effect of the electric light on plants is to stimulate their growth and improve their condition. This being a fact, it is reasonable to suppose that it might have the same effect on animal life, and, indeed, recent experiments with the electric light bath upon the bodies of patients have shown this to be the case. It is in the diseases of the nervous system that it finds one of its most useful spheres of influence. Not only is it valuable in determining the site of disease, but it gives us most healthful aid in neuralgic affections and paralysis. Above all, it is one of the safest and best general tonics at our command."

THE jury of awards of the Atlanta Expoition, with President Gilman at the head, will assemble in Atlanta on October 15. Among the members of the jury are the fol lowing:

Gen. Henry L. Abbot, United States Engineers, 'Engineering, and Public Works.'

President C. K. Adams, of the University of Wisconsin, 'Liberal Arts.'

Prof. N. Murray Butler, of Columbia College, 'Education.'

G. Brown Goode, of the Smithsonian Institution, 'Fisheries.'

Morris K. Jesup, President of the American Museum of Natural History, New York, 'Museums, Parks, etc.'

President T. C. Mendenhall, of the Worcester Technological Institute, 'Machinery.'

Prof. Simon Newcomb, F. R. S., 'Instruments of Precision.'

Prof. Ira Remsen, Baltimore, 'Chemistry.'

Prof. Henry A. Rowland, F. R. S., Johns Hopkins University, 'Electricity.'

THE State Geological Survey of New York, according to the *Engineering and Mining Journal*, has been busily at work this summer. Prof. Charles W. Comstock, one of the professors of engineering at Cornell University, who has done excellent work on the surveys in Colorado, is in charge of work on the upper Hudson district with numerous able assistants. Prof. C. Wellman Park, recently in charge of the department of physical science at the Rensselaer Polytechnic Institute, has charge of the survey work in Franklin county, with a large corps of men engaged in making surveys of large tracts of State land on township 24, etc., near the Saranac Lakes. Mr. Monroe Warner, recently a United States Deputy Surveyor for South Dakota, is at work with a party in townships 1 and 2 of Totten & Crossfield's purchase in the county of Hamilton, near Scandago Lake and Lake Pleasant. Mr. Solomon Lefevre, formerly an assistant on the New Jersey Geological Survey under Prof. Cook, is in charge of surveys in the district of the Indian River and West Canada Creek, Vrooman's patent, Herkimer county. Perhaps one of the most important results of the work accomplished of general interest will be some computations made by Prof. Olin H. Landreth, formerly of Vanderbilt University, Nashville, Tenn., now professor of mechanics and engineering at Union University.

MACMILLAN & Co. announce a translation, by Mr. A. J. Butler, of Professor Frederick Ratzel's History of Mankind, to be published in thirty monthly parts. There will be a preface by Professor E. B. Tylor and the work will be elaborately illustrated.

MR. E. H. GRIFFITHS opened a discussion at the recent meeting of the British Association on Heat Standards. He said the thermal capacity of water had been taken as a standard since the time of Black, but caused many inconveniences. The different heat units proposed were: (1) the specific change per degree centigrade of the product of pressure and volume of a gramme of hydrogen, by Macfarlane Gray; (2) the latent

heat of evaporation of a gramme of water at ordinary pressure, by Joly; (3) the latent heat of fusion of a gramme of ice, by Pickering. But none of these are simply related to other units, and they are arbitrary. He suggested a thermodynamic unit—namely, the heat energy of 42 million ergs. This is a natural and an absolute unit, independent of the researches of any observer, and convenient in magnitude. It may be interpreted practically as the amount of heat required to raise a gramme of water 1 deg. C. at 10 deg. C., as measured on a hydrogen thermometer.

UNIVERSITY AND EDUCATIONAL NEWS.

THE buildings of the University of the City of New York at University Heights will be formally opened on Saturday, October 19th. The two buildings that will be dedicated are the Hall of Languages and the Havemeyer Laboratory. The new gymnasium is also finished and will be open for inspection. Dr. Anson Judd Upson, Chancellor of the University of the State of New York, will make an address and speeches are expected from Governor Morton, Mayor Strong, Dr. Wm. T. Harris, President Hill of Rochester and President Gates of Amherst. Part of the dedicatory exercises will be the breaking of ground for the new library building.

THE Freshman class in the academic department of Yale University numbers 330, one less than last year. The Freshman class in the scientific department numbers 149, a decrease of 101 as compared with last year. This decrease is attributed to changes in requirements of admission. There are this year 149 graduate students, as compared with 138 in 1894 and 143 in 1893. The number of professors and instructors is this year 227, an increase of 20. The professorships of natural philosophy and astronomy and of botany have not been filled.

BY the will of Col. W. L. Chase $5,000 is bequeathed to the president and fellows of Harvard College to establish a scholarship in the medical school, to be known as the Charles B. Porter scholarship.

DR. FREDERICK F. DUNLAP, a graduate of the University of Michigan, has been called to an assistant professorship of organic chemistry in Yale University.

AT the Ohio Wesleyan University, Professor Albert Mann, Ph. D., who has recently returned from Munich, has entered upon his new field of labor in the biological department. The enrollment of students in this department is twice as great as during any preceding year in the history of the College. Professor Trumbull G. Duvall, Ph. D., has just resigned the chair of philosophy at DePauw University, in order to take charge of the department of philosophy. Mr. Duvall is establishing a fine departmental library in connection with his philosophical instruction at the University. Lieut. Waldo E. Ayer, of the 12th U. S. Infantry, has been detailed by Secretary Lamont as professor of military science and tactics. Prof. Ayer will report at the University for duty immediately.

MR. DANIEL T. MACDOUGAL has lately been appointed assistant professor of botany in the University of Minnesota. He will have charge of the graduate and undergraduate courses in plant physiology. Miss Josephine E. Tilden has been awarded the Albert Howard Fellowship on the basis of her work on American fresh-water algae.

A NEW $40,000 laboratory building is about completed for the departments of bacteriology, histology and pharmacy in the medical college of the University of Minnesota.

THE recently published 'Directory of the Officers and Students of Brown University' shows a total enrollment of 844 students, an increase of 104 over that of last year.

THE number of students in the school of biology of the University of Pennsylvania has greatly increased. More than 300 students are taking the biological courses, about one-third of these being women.

THE Spring Garden Institute of Philadelphia has received a gift of $100,000 from the heirs of Samuel Jeanes, who supported the Institute with great generosity during his lifetime.

M. H. WHITE, of Cincinnati, and his brother, F. T. White, of New York, have given $25,000 to Earlham College at Richmond, Ind., in memory of their father, the late John T. White. The College is supported by the Society of Friends.

DR. A. H. THORNDIKE has been appointed instructor in mathematics in Boston University.

DR. G. P. GRIMSLEY, of Topeka, Kansas, has accepted the professorship of geology and natural history in Washburn College.

LAFAYETTE COLLEGE will hold a celebration on October 24th in honor of Professor Francis A. March, the distinguished philologist, who this fall completes his seventieth year and forty years of service in the College. The exercises will begin at 11 a. m., in the auditorium of Pardee Hall, ex-President W. C. Cattell presiding, and will consist of an address by Professor W. B. Owen on Dr. March and his work for Lafayette, and several addresses by Dr. March's fellow laborers in the field of English language and philology; Dr. Wm. T. Harris, U. S. Commissioner of Education; Professor T. R. Lounsbury, of Yale; Professor J. W. Bright, of Johns Hopkins, and Professor Thos. R. Price, of Columbia.

LEHIGH UNIVERSITY celebrated Founder's Day on Thursday, October 10th. An address was delivered in the Packer Memorial church by the President, Dr. Thomas M. Drown.

THE Council of University College, Dundee, has appointed to the new Harris chair of physics Dr. J. P. Kuenen, Ph. D., of the University of Leyden, Holland.

MR. GEORGE SAINTSBURY has been appointed professor of rhetoric and English literature in the University of Edinburgh.

DR. W. BIEDERMANN, professor of physiology at Jena, has received a call to the University at Graz. Dr. Adolf Heydweiller, of Strassburg, has been made assistant professor of physics in the University of Breslau.

DR. OTTO JAEKEL has been promoted to be a professor of paleontology at Berlin.

CORRESPONDENCE.

PROFESSOR BROOKS ON CONSCIOUSNESS AND VOLITION.

IN SCIENCE of October 4th Professor Brooks has a letter on two communications in previous numbers by Professor Gage, of Cornell University, and myself, in which he expresses objections to them. It is necessary that I state the names of the authors of these articles, as Professor Brooks unaccountably does not do so.

Professor Brooks' objection is to a supposed assumption of knowledge on the part of these persons which he is sure that they do not possess, and he is willing to characterize their assumption by no worse a term than 'poetry.' In any case, he says, it is not science. His objections extend not only to the papers criticised, but to the societies which are supposed to have endorsed such views by electing one of their authors 'many times president;' they will logically extend also to the societies who have elected the other one president, though Professor Brooks does not refer to them.

Professor Brooks' specific objection is to the assumption that "consciousness and volition can cause structure or anything else." He also varies the proposition thus: "If we admit, as I think we must, that for all we know an oak tree may have volition and may do as it likes, what evidence is there that it ever likes to do anything which it would not do in any case by

virtue of its structure even if it were unconscious."

I have much respect for Professor Brooks' abilities and work as a biologist, but in the above sentences he commits the common error of confounding volition with consciousness in a way which will surprise any student of mental phenomena. I am not aware that any well-read person in modern times has proposed the hypothesis that 'volition,' or doing 'as it likes,' is a property of the vast majority of protoplasms, while every naturalist knows that consciousness is a property of protoplasm, though not of all protoplasm so far as our means of observation permit us to judge. Students of cells and tissues are very frequently not students of consciousness, and I will therefore add another commonplace of psychology, and that is that the responses of conscious protoplasm to stimuli are as strictly regulated by necessity as the responses of unconscious protoplasm, though the necessity is of a different kind.

The proposition that a muscular contraction is influenced, *i. e.*, directed by a conscious state, may be a matter of mere opinion, or it may be a working hypothesis, or it may represent a fact. Mankind generally, including many scientific men, hold it to be a fact. Lord Kelvin, according to Prof. Gage, is of this number, though he calls it a 'miracle.' However, Prof. Brooks will probably allow that it is a permissible working hypothesis, although he does not say so directly. If we grant that it is true of man, which most of us do, no one has yet shown where the line is to be drawn, as we descend the scale of animal life, at which sensation ends. In fact, centers of special sense are alleged to exist in many Protozoa, and if special sensation exists it is probable that general sensation exists still lower down in the scale.

As to whether such sensation, if it exists, has any effect on structure, the reasons for thinking that this occurs through the medium of movements have been stated so often that it is not necessary to repeat them here. I only refer for a resumé of some of the evidence to a book by myself which will probably be issued by the Open Court Publishing Co. by the beginning of next month.

A common source of obscure thinking among naturalists is the assumption that reflex and automatic acts disprove the agency of conscious states in the direction of movements. Evolutionists, however, look for the origin of things, and some of them find consciousness, as a cause of the direction of new movements now, to be an equally supposable cause of new movements at former periods of the earth's history. Here we have again a legitimate working hypothesis; although it is not necessary to account for all the movements of organic matter.

Of course, the opposing view to the hypotheses above mentioned involves the assumption of their falsity. To give the opppsite position the standing in court adopted by Professor Brooks, I quote him with variations, as follows: "If the learned bodies which give their allegiance to the utterances I have quoted will publish the evidence that consciousness and volition can" influence Professor Brooks when he writes a learned article, or makes an address on a biological subject, "they will not only demonstrate their own scientific eminence, but by settling a question which has never ceased to vex the mind of man they will make the closing years of the nineteenth century memorable for all time," etc. Thinkers will adopt one or the other of these hypotheses as they see fit, but when they touch the metaphysical side of the question they must give to it that attention which it deserves.

Professor Brooks' plea for suspense of judgment is wise. But the formulation of a hypothesis need not alarm him. Builders generally know the difference between the scaffolding and the building. And a builder will value the indication of faults in his scaffolding rather than general disquisitions on the uselessness of scaffolds in general.

E. D. Cope.

P. S. I hope to make shortly some comments in the pages of the American Naturalist on previous articles in Science by Profs. Baldwin and Cattell.

Absorption of Terrestrial Radiations by the Atmosphere.

I am certainly glad that Prof. Davis (Science p. 485, Oct. 11, 1895) objected to the extreme terms which I used in referring to the blanketing effect of our atmosphere. I object to them

myself, and must have used them in a moment of mental aberration. I should have said that the bolometer had given us most of the reliable data concerning the absorption and transmission of radiant energy by the atmosphere, although at that time I fully believed, both from a general knowledge of Prof. Langley's work, and from conversations with him, that the atmosphere was a pretty good valve. Prof. Davis's references and a recent study of the published data show that the valve is leaky indeed. Still, if the atmosphere absorbs 50% of the Sun's radiations, and 50% of those from the earth, we have 25% of the Sun's radiations let in and not let out. If we take the figures which I believe Langley recommends, 70% for the solar, and 40% for the terrestrial radiations, we should have a catch of 40% of that originally arriving from the Sun.

Many unexplained points concerning this complex problem continually appear. What becomes of the 30–40% of the solar radiations and the 40% of terrestrial radiations absorbed by the atmosphere? It has but little mass and low specific heat, and yet it does not get hot, except in its lower layers. This source of energy it seems to me would be more than sufficient for all meteorological phenomena. Prof. Langley's data, voluminous and wonderful as they are, still appear incomplete in certain very important directions, leaving a very attractive field for investigation.

As to terminology, it seems to me very convenient to speak of 'heat rays' so long as we know exactly what we mean by the expression. We are all familiar with 'light rays,' and a 'heat ray' is the same thing, only, as Maxwell says, considered in its 'thermal aspect.' The term 'ray' is no doubt bad, but it is convenient and should be permissible with a tacit understanding that it is only a makeshift term. It would, of course, be better if we had some term to signify energy in its radiant form, as to direction of propagation, wave front, etc., but so long as we have not, and inasmuch as we all recognize its identity, why not use the old names and avoid multiplication of words. Even Prof. Langley's 'Luminous heat' ought to mislead no one; evidently he refers to the heat effects of that kind of radiant energy which is also capable of producing light effects; 'dark heat rays' are incapable of so doing. When Professor Langley speaks of the 'radically different character of the heat in two maxima' he refers, of course, to their different wave-lengths. A similar remark about a treble and bass note would not mislead any one into the idea that both were not sound. I fail to see what is wrong with the last quotation from my article, or exactly what is meant by the 'mis-recognition of the early part of this century.'

I sympathize most sincerely with Professor Davis in his demand for precise terminology, but we must not allow even this worthy desire to lead us into complexities of expression which may be even more fatal to perspicuity than old terms with modern significations.

W. HALLOCK.

COLUMBIA COLLEGE, October 11, 1895.

A REPLY.

EDITOR OF SCIENCE: If it be fair to presume, as does Dr. Emory McClintock on page 453–4 of SCIENCE, under a heading which I think should be 'Professor Halsted Corroborated,' that because neither in a private letter nor in print one specifies his many mistakes, therefore one did not disapprove both his 'half on Saccheri as well as the half on Gauss,' then I must beg of SCIENCE a line to say that among other mistakes in this letter of his, he is completely wrong in saying of me: "He found that the two words *diuturnum prœlium* were meant by Saccheri to indicate a mental attitude of constant war against the 'hypothesis' as heretical."

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS, October 7, 1895.

THE RUDOLF LEUCKART CELEBRATION.

SEVERAL months ago the following circular (Cf. SCIENCE, Vol. I., p. 187) was sent out from Leipzig,s igned by about a hundred and fifty scientists from various parts of the world:

"*Zur Feier des am 13 December, 1895, stattfindenden fünfzigjährigen Doctorjubiläums von Rudolf Leuckart*, dem Nestor unter den deutschen Zoologen, dessen Wirken weit über den Kreis seiner Specialwissenschaft hinausreicht, fordern die ergebenst Unterzeichneten zu Beiträgen auf. Im Herzen seiner zahlreichen

Verehrer steht es fest, dass der seltene Tag nicht vorbei gehen darf ohne ein dauerndes Zeichen der Erinnerung. Wir gedenken von einem hervorragenden Bildhauer 'Leuckart's Marmorbüste' herstellen zu lassen und sie zugleich mit einer künstlerisch ausgestatteten Adresse zu überreichen.

"Wir wenden uns an alle, welche in ihrem geistigen Entwickelungsgange sein Wirken und seinen Einfluss verspürt haben, dass sie zu einer würdigen Ehrung des Jubilars beisteuern.

"Da es unmöglich ist, die Adressen aller seiner Schüler, namentlich derer, die nicht Zoologen von Fach geblieben sind, zu erlangen, so bitten wir diejenigen Herren, welche der allgemeinen Anregungen, die sie aus Leuckart's Vorlesungen in ihren Beruf mit hinausgenommen haben, in Dankbarkeit gedenken, dass sie in ihren Kreisen durch Verbreitung dieses Aufrufs in unserem Sinne thätig sind.

"Beträge werden erbeten an Herrn Carl Graubner (C. F. Winter's Verlag, Leipzig, Johannesgasse 8), welcher das Amt des Schatzmeisters freundlichst übernommen hat."

Within a few weeks of the receipt of the circular by American zoölogists I received a number of inquiries from various sources asking for further information regarding the subject, but was unable to reply to these inquiries, as I had not learned the detailed plans of the Leipzig Committee. At present, however, I can furnish some of the desired information, and, as the time is very short, will utilize the columns of SCIENCE for this purpose.

It is the intention of the Leipzig Committee to have a life-size marble bust of the Geheimrath made and to present it to him on December 13th, and it is understood that the bust will eventually be deposited in the University at Leipzig or in the Leipzig Gallery. The statue will be made by one of the most prominent sculptors of Germany, who attended Leuckart's lectures this last semester, unbeknown to the lecturer, in order to study his expression. The estimated cost is 4,000 marks, of which about 1,000 marks had been subscribed before September 1st. Should more money be collected than is necessary it will probably be spent for photographs of the bust which will be sent to persons who have forwarded subscriptions.

The subscriptions thus far made vary from 10 to 200 marks, most of them being in sums of 20 to 50 marks.

It is not intended to confine the subscriptions to Leuckart's pupils, for a number of other persons have expressed their desire to contribute. The Leipzig Committee therefore extends a cordial invitation to all admirers of the Geheimrath to join in the celebration, and I would therefore urge all of Leuckart's pupils in this country to bring this circular to the attention of their scientific and medical friends.

Subscriptions can be sent to Carl Graubner, as announced in the original circular, or to me. At the request of Dr. Simroth, the moving spirit in the undertaking, I have agreed to receive American subscriptions and forward the same in one sum to Leipzig.

CH. WARDELL STILES.

U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

TO THOSE INTERESTED IN QUATERNIONS AND ALLIED SYSTEMS OF MATHEMATICS.

DEAR SIRS: The mathematical ideas associated with the direct treatment of vectors and vector functions are daily becoming more familiar to the scientific mind. Half a century ago the broad principles of vector theory were laid down in the Quaternions of Hamilton and the Ausdehnungslehre of Grassmann. In his second monumental work Hamilton developed a vector calculus of great power and flexibility, peculiarly appropriate to geometry and physics; while both systems, in their richness of transformations, generality of treatment, simplicity of expression and interpretation, surpass any other known forms of mathematics. Nevertheless, these systems have not received the attention that is surely their due, and remain still in a comparatively undeveloped state.

Meanwhile, in connection chiefly with the remarkable advance in electrical theory, the growing necessity for a vector calculus, or at least for a compact vector notation, has induced more recent investigators to invent new systems, which have very much in common with those already established by Hamilton and Grassmann.

The time, therefore, seems to be ripe for a combination of forces, so that workers in these important lines may become known to one another, and the enthusiasm of students excited and sustained.

Led by these considerations we venture to suggest the organization of what we provisionally call 'the International Association for promoting the Study of Quaternions and allied systems of Mathematics.' By such an organization vector analysis would receive a great impetus. A journal published from time to time would keep the members of the Association in touch with the various aspects of the subject, both pure and applied, and would facilitate interchange of opinions on the introduction and adoption of new notations.

In these few lines we have tried to point out the important task of the Association, but shall be obliged for any suggestion or improvement. It is almost needless to say that we are only preparing the way; and once the Association has been started we shall be ready to place it in the hands of persons much more competent than ourselves to further its best interests.

We earnestly hope that all friends will appreciate our endeavors and show us at once some token of approval.

We remain, Dear Sirs,

Very respectfully yours,

P. MOLENBROEK, the Hague, Holland.

S. KIMURA, Yale University, U. S. A.

October, 1895.

N.B.—We would ask those who are in Europe to communicate with the first of the above names, and those in America with the second.

SCIENTIFIC LITERATURE.

Proceedings of the International Electrical Congress, Chicago, 1893. American Institute of Electrical Engineers. Edited by Max Osterberg.

The publication of this volume of nearly 500 pages insures a permanent record of the Chicago Electrical Congress and gives evidence of the value and importance of its work. The Congress was unique in its composition, since it consisted of both an official and an unofficial body. The 'Chamber of Delegates' was a small body representing ten governments and composed only of those presenting duly authenticated official credentials.

It may be said in this connection that while the expenses of the official representatives of foreign governments were paid, as far as known to the writer, our own government went only so far as to appoint representatives through its Secretary of State, but neither paid expenses nor, what is of much more importance, provided in any way for the meeting of this body of officially delegated scientific men from abroad, and took no official notice of them. This neglect was a source of great chagrin to the representatives of the United States. It would be impossible in Europe, with the sentiment prevailing there respecting the official etiquette befitting such an occasion.

The papers printed in this volume constitute a valuable collection of great variety, and no one interested in the higher phases of electrical theory and practice can afford to be without them. It is gratifying to know that the sales of the 'Proceedings' have already nearly or quite met the cost of publication, while a goodly number of volumes remain in the possession of the Institute.

An omission of some importance, in view of subsequent controversies, occurs in the report of the 'Proceedings of the Chamber of Delegates.' I refer to the appointment of the committee on notation and nomenclature. The presentation of the committee's report is noted, but one looks in vain for the names of the gentlemen composing it.

Inasmuch as a committee was appointed to draw up specifications for the Clark cell, consisting of Messrs. Helmholtz, Ayrton and Carhart, it may not be amiss to explain here why this committee never reported.* The chairman, Professor von Helmholtz, it will be remembered, was seriously injured on his return trip to Europe, and this unfortunate accident delayed action. The writer, however, received finally a long official communication from him in relation to the Clark cell and the legalization of the units adopted by the Congress. The proposals of von Helmholtz were accepted by myself with some slight modifications. Some correspond-

* *Proceedings*, p. 20.

ence was also had with Professor Ayrton, which served to clear up points of uncertainty. The committee of the British Board of Trade, however, preferred to adhere to the test-tube form of cell and proceeded to secure the legalization of their own specification without reference to the finding of the international committee. The work had all been done by the committee before the death of von Helmholtz, except the drawing up of a formal report. Upon the appointment of the committee of the National Academy of Sciences, all the information in the hands of the writer and the conclusions reached by the majority of the international committee were communicated to the chairman of the new committee, and they are embodied in his report (see Mis. Doc. No. 115, 53d Congress, Senate). I take pleasure in adding that the specification relating to the Clark cell, which was reported to Congress by the Academy committee, meets my entire approval and has some points of superiority over that legalized by the English 'Order in Council.' It is not likely, however, that any discrepancies between the E. M. F.'s of the two will be found to exist.

It seems necessary to add that the volume now under review is somewhat seriously marred by many typographical and other errors. The proof should certainly have been read by more than one person and by some one familiar with the details of the Congress.

Henry S. Carhart.

The Alps from End to End. By Sir William Martin Conway. Westminster, Constable. New York, Macmillan & Co. 1895.

Sir William M. Conway, who has gained distinction among explorers of high mountains by his expedition to the Himalayas, made a rapid scramble over the Alps from end to end in the summer of 1894, and now presents a simple narrative of his excursion in a rather large book of four hundred pages with a hundred full-page plates; the latter being notable for the high average elevation of the points of view. Having taken Swiss guides to aid him in the Himalayas, Conway now brings two Gurkhas—natives of Nepal—to go with him over the Alps, at the same time advancing their mountaineering education, and thus enabling them better to assist in Himalayan exploration on their return to the East. The use of a compass, an aneroid and a good contour map to find the way in the clouds is ingenious and worth learning. There is extremely little physiographical or geological matter in the book, but it abounds with the minutiæ of personal incidents. For example, opening the book at random, we read: "On calling for provisions we found that the men had devoured all the fresh meat at breakfast, and that the day was to be a bread-and-butter one. Fitzgerald and I purloined the end of a sausage in revenge. It was easily secreted, but the straits to which we were put to eat it secretly," etc., etc. Of a day opening with rain it is frankly recorded: "We were delighted to hear that the morning was one for bed rather than mountains;" the glory of trips at headlong speed being apparently in having done them rather than in the doing. The book records a redoubtable athletic experience, but almost any one might write a volume if such shadowy substance is worthy of permanent record in large pages with open type. The only chapter of scientific value is on Mountain Falls; this being based chiefly on the account by Buss and Heim of the landslide of Elm, Canton Glarus, in 1881. W. M. D.

A Handbook for Surveyors. By Mansfield Merriman and John P. Brooks, of Lehigh University. New York, J. Wiley & Sons, 1895. 16 mo., pp. 242.

This little book is at once text-book and field reference book for students and for surveyors in the field. It contains, in compact and systematic form, the information, the principles and the methods of surveying, so far as required in advance of the subject of railroad location—those of land and town surveying, leveling, triangulation and topography. It is given the pocket-book form in order that it may be conveniently used in the field, where its tables are likely to be at any moment useful, and where reference to the text-book is sometimes found advisable by the old practitioner as well as by the student and novice. Special attention is given to the testing of instruments and their comparison, and standard methods with some excellent new processes are described with the

lucidity and accuracy characteristic of these writers. A dozen tables are appended, the natural functions being given to five, and the logarithms and functions to six places of decimals. The book seems likely to prove very useful to a large class of engineers and surveyors and should find ready and extensive sale.

SCIENTIFIC JOURNALS.

THE MONIST, OCTOBER.

AFTER a careful examination of Darwin's own statements upon the matter, and a brief survey of the theories of Wallace, Weismann, Cope and the Neo-Lamarckians, Geddes, Henslow and others, the late Professor G. J. Romanes concludes, in the leading article of this number, on *The Darwinism of Darwin and of the Post-Darwinian Schools*, that Darwin's answer to the question whether the so-called Lamarckian factors were involved in the progressive modification of living forms was distinct and unequivocal, and that he never maintained that natural selection was to be regarded as the *sole* cause of organic evolution. As the mean between the two extremes of American Neo-Lamarckism and European Weismannism, Prof. Romanes believes that Darwin's judgment with respect to the relative importance of the factors of evolution will eventually prove the most accurate of all. Romanes' criticism of the American Neo-Lamarckians is that they do not distinguish between the 'statement of facts in terms of a proposition and an explanation of them in terms of causality,' but the bulk of the article is devoted to demolishing the erroneous and widely current impression implied in the so-called 'pure Darwinism' of Mr. Wallace, and especially to refuting the latter's conception of the intervention of a distinct individual intelligence in evolution.

Dr. Paul Topinard, in the second article, *Man as an Animal*, seeks to assign man's place in nature by a review of the results of anthropology, which for him is a branch of natural history pure and simple. His general conclusion is that man is not a creature apart in creation, but an animal like all the rest, only adapted and perfected to intellectual life; and that from this point of view his interests and impulses are all individual and egotistic. In details his views are opposed to prominent American theories on this subject.

In *Criminal Anthropology Applied to Pedagogy*, Prof. C. Lombroso shows how the conclusions of criminology can be turned to practical account by teachers in their treatment of children. His article indicates more clearly than most of his writings do what are the limitations of his doctrine of the criminal type.

By *Arrested Mentation* (fourth article) G. Ferrero understands that law of natural logic by which the person of average power and education stops short in his reasonings at facts and phenomena falling under the notice of the senses, never pushing his inquiries after causes beyond the *obtrusive* facts of his experience. He also includes under this term our penchant for syllogistic reasoning, as opposed to the laborious and repellent methods of inductive research, and gives well-known historical examples in illustration of his idea.

The three last articles form a logically coherent group on the moral and religious upshot of scientific inquiry. That on *Naturalism* by Professor C. Lloyd Morgan is a defense of science against the recent animadversions of Mr. Balfour, and finds that Mr. Balfour's onslaught is directed against a wholly imaginary conception of the naturalistic tenets, and one which is never held by the foremost representatives of scientific thought. Dr. Paul Carus in *The New Orthodoxy* makes a plea for that 'rightness of opinion' which proceeds from the rigorous observation of the *objective* criteria of truth established by science. In *The Fifth Gospel* Dr. Woods Hutchinson, of the University of Iowa, announces a new evangel—the Gospel according to Darwin—which, the author claims, places morals and religion on firmer foundations than ever before.

Prof. F. Jodl reviews the philosophical publications of Germany and Austria, M. Lucien Arréat those of France, and Theodore Stanton writes on some French opinions of the Chicago Congresses. Emilia Digby discusses Prof. Le Conte's view of 'social evolution through the ethical law.' Numerous book reviews. Contents of Periodicals.

THE JOURNAL OF COMPARATIVE NEUROLOGY, JULY.

The Mammalian Cerebellum. Part I. The Development of the Cerebellum in Man and the Cat: By Bert Brenette Stroud. This paper is introduced by sections on technique and terminology; also by an historical review. The development of the cerebellum of both man and the cat is presented in a series of drawings and descriptions of all of the important stages. In 1891 Herrick gave a brief description of the development of the cerebellum of the mammal and reptile, in which he showed that this organ arises not from a median anlag, but from two lateral centers of proliferation from which the neuroblastic elements migrate dorsad and mesad. In 1894 Schaper verified and amplified these observations in the teleosts. Mr. Stroud has fully illustrated the process in his two types, and has then traced the development of each of the major divisions of the adult organ. His paper is accompanied by eight plates and a bibliography.

Notes on Child Experiences: By C. L. Herrick. I. Anthropomorphization of Numerals. The strong tendency of children toward personification has led in the case cited to a phenomenon not unlike pseudochromæsthesia. The boy of ten years habitually personifies and visualizes his numerals and attributes to each a moral nature in keeping with his form. II. Hallucinations of Vision in Children. In the course of a description of certain unusually vivid visual hallucinations which the author experienced in his own childhood, he takes occasion to criticise the recent statistical studies of the power of visualization. The average untrained observer is unable to tell whether he truly visualizes or not, so that much of the work done on the basis of recent statistics is is fallacious.

The Cerebral Fissures of two Philosophers, Chauncey Wright and James Edward Oliver: By Burt G. Wilder. A brief comparison of the fissural patterns of these brains shows, in both, the frontal region unusually high and wide and the supertemporal fissure larger than common; but the very exceptional features of Wright's cerebrum are not repeated in Oliver's. But all estimates of the extent and significance of their peculiarities will be only provisional until the careful comparison of many average brains supplies one or more types or standards.

Formalin for the Preservation of Brains. [Preliminary Note]: By Pierre A. Fish. A minimum shrinkage and loss in weight, cheapness and rapidity of action are the advantages claimed for the mixture proposed.

The Physiological Condition of Consciousness: By Dr. Paul Carus. This article was called out by Professor Herrick's reply to Dr. Carus' article in the Journal of Comparative Neurology for September, 1894. Dr. Carus defends his use of the words 'feeling' and 'intelligence,' and reviews his arguments for regarding the corpus striatum as the seat of consciousness in the sense of an organ by which through some kind of a mechanical arrangement the connection between the memory-images are established so as to produce by their interaction the condition of consciousness. A bibliography accompanies the paper.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

The first regular meeting of the year 1895–96 was held on Monday evening, October 7. No formal program had been announced beyond regular business, but after this had been transacted, the members present gave personal sketches of the work of the summer, and touched particularly on the meetings of the American Association, its affiliated societies and the British Association.

A proposed plan for the meeting of the British Association in joint session with the American Association at San Francisco in 1897 was brought up and informally discussed, but no action was taken.

J. F. Kemp,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

A regular meeting of the Academy was held on the evening of Friday, October 4, at which the annual address by the President, Dr. George Bruce Halsted, was given, the subject being 'The Culture Given by Science.'